DOCUMENT RESUME

ED 398 383 CE 072 125

TITLE	The New Industrial Electrics/Electronics Occupations.
INSTITUTION	German Federal Inst. for Vocational Training Affairs, Berlin (Germany).
PUB DATE	[96]
NOTE	89p.; For a related document, see CE 072 126.
PUB TYPE	Guides - Non-Classroom Use (055)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	*Course Descriptions; *Electrical Occupations; *Electronics; Electronic Technicians; Foreign Countries; *Industry; *Occupational Information; Postsecondary Education; *Technology; Vocational Education
IDENTIFIERS	*Germany

ABSTRACT

This publication provides information on occupations in industrial electrics/electronics in the Federal Republic of Germany. Section I contains the German vocational training regulations for these occupations, including an overview of training, examinations, and the new notion of qualification. A chart illustrates the structure for training in three major occupational fields--power electronics, industrial electronics, and communications--and the additional occupation of electrical machine fitter. Section II provides descriptions and profiles of the following occupations: electrical machine fitter; power electronics mechanic specializations: plant technology and operations technology; industrial electronics mechanic specializations: production technology and equipment technology, and communications fitter specializations: information technology, telecommunications technology, and radio technology. A description of the occupation includes duration of vocational training and tasks. The occupation profile lists skills and knowledge with standard times in weeks for year 1, 2, or 3. Section III consists of regulations concerning vocational training for the occupations. Appendixes include the general syllabuses for the basic, specialized, and any advanced vocational training of electrical machine fitters, power electronics mechanics, industrial electronics mechanics, and communications fitters. (YLB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 398 383

The new Industrial Electrics/Electronics Occupations

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

H Blütz

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

BEST COPY AVAILABLE

CE 072 125

Federal Institute for Vocational Training
Der Generalsekretär

Contents

		Page
I	**The German Vocational Training Regulations for Occupations in Industrial Electrics / Electronics**	5
II	**Occupations in Industrial Electrics/Electronics in the Federal Republic of Germany**	13
	Descriptions and Profiles of: Electrical Machine Fitter	14
	Power Electronics Mechanic Specialization: Plant Technology	16
	Power Electronics Mechanic Specialization: Operations Technology	18
	Industrial Electronics Mechanic Specialization: Production Technology	20
	Industrial Electronics Mechanic Specialization: Equipment Technology	22
	Communications Fitter Specialization: Information Technology	24
	Communications Fitter Specialization: Telecommunications Technology	26
	Communications Fitter Specialization: Radio Technology	28

Contents

		Page
III	**Regulations Concerning Vocational Training for Occupations in Industrial Electrics/Electronics and the Occupation of Communications Fitter in the Federal Postal Administration**	31
	Annex 1 General Syllabus for the Vocational Training of Electrical Machine Fitters	
	I. Basic Training	43
	II. Specialized Training	47
	Annex 2 General Syllabus for the Vocational Training of Power Electronics Mechanics	
	I. Basic Training	54
	II. Specialized Training	58
	III. Advanced Training in Subject Areas	61
	A. Plant Technology	
	B. Operations Technology	63
	Annex 3 General Syllabus for the Vocational Training of Industrial Electronics Mechanics	
	I. Basic Training	65
	II. Specialized Training	69
	III. Advanced Training in Subject Areas	72
	A. Production Technology	
	B. Instrument Technology	74
	Annex 4 General Syllabus for the Vocational Training of Communications Fitters	
	I. Basic Training	77
	II. Specialized Training	81
	III. Advanced Training in Subject Areas	84
	A. Information Technology	
	B. Telecommunications Technology	86
	C. Radio Technology	88

I

The German Vocational Training Regulations for Occupations in Industrial Electrics / Electronics

I. The German Vocational Training Regulations for Occupations in Industrial Electrics/Electronics

The Regulations concerning Vocational Training for Occupations in Industrial Electrics/Electronics and the Occupation of Communications Fitter in the Federal Postal Administration are ordered according to three major occupational fields: power electronics, industrial electronics and communications. An additional occupation is that of electrical machine fitter. For power electronics mechanics and industrial electronics mechanics there are two specialized subject areas each and three for communications fitters.

For all occupations, the training lasts three and a half years. It is conducted in training workshops in companies and locally in various company departments. In addition to this, the trainee attends lessons at a part-time vocational school one or two days a week. A private training contract is concluded between the trainee or his legal representative and the training enterprise. The trainees receive a training allowance in accordance with related wage agreements.

The training is phased into four stages (see chart): In the first year the trainee undergoes an initial basic training common to all occupations, from metalworking activities like sawing, boring/drilling, filing to wiring, laying transmission lines to measuring and testing electronic modules.

This basic training is the same as for the six crafts occupations in electrics/electronics (omitted here).

After this, the specialized training begins. In terms of subject matter, it is identical for all electrics/electronics occupations for the first half-year. In the next (fourth) training half-year, the specialized training is then conducted separately according to the various occupations. From the third year onwards, the specialized training is imparted according to specialized subject areas (except for the occupation of electrical machine fitter).

In the fourth training half-year an interim examination is held to review the level of educational attainment. The results do not, however, form part of the final qualification.

The final examination consists of a practical and a written section. The successful examinee then receives his craft certificate.

Heavy emphasis is placed on electronics during the training. The General Syllabus specifies for example the assembly of electronic

modules, the insertion of components into printed circuit boards and the designing and testing of computer programmes.

The training subject matter also includes environmental protection and the rational utilization of energy.

This subject matter is imparted so as to enable the trainees to think in interrelated terms, to plan and solve problems independently.

Until the new Regulations in 1987, the electrics/electronics occupations were regulated in the Regulations on Phased Training (Stufenausbildungsordnung) of 1972. In agreement with the representatives of employers and labour, they were elaborated by the Federal Institute for Vocational Training in Berlin based on the 1972 Regulations. This work reached completion with the issuance of the new Regulations in 1987.

In the 60s concepts of phased training were discussed with the aim of reforming vocational training. The idea of such phased training was to systematize vocational training and cater for different aptitudes and inclinations amongst trainees and industry's need for different qualifications in skilled manpower.

After the Regulations on Phased Training in electrics/ electronics were issued, it became apparent, however, that these goals were not compatible and that the transition from the first to the second stage of training gave rise to many conflicts. In addition to this, the Regulations of 1972 were no longer in line with modern technological developments.

In response to these problems, employers and unions agreed on 'Joint Goals for the Further Development of Occupations in Industrial Electrics/Electronics'. The major outcome of this agreement was the abolition of phased training. No new Regulations were agreed on; agreement was reached on 'further development', i.e.

- The occupations of the second phase (electronics) had evidently proved their worth. It was simply a matter of examining whether changes in the course of training might prove necessary as a result of the abolition of phasing while at the same time retaining the level of specialist qualifications achieved hitherto.

- In the occupations of the first phase (electrics), the skilled worker qualification was not achieved. The employers complained above all that there was a lack of 'professional maturity'. These occupations would therefore have to be further developed so as to achieve skilled worker qualification. The training was to last at least three years.

The research work began in the Federal Institute for Vocational Training at the end of 1982. The studies on activities came to the following conclusions:

- Materials processing, connecting and fabricating windings and cable harnesses were less important.
- Handling circuit diagrams, tables, manuals, measuring electrical variables, testing electrical functions, start-up and commissioning were more important.
- Less knowledge ought to be imparted in the part-time vocational schools that was of no or only little application in companies, e.g. electrochemistry, magnetic and electric fields, semiconductor physics.
- The subject matter of the training was to be adjusted to the new technological developments. Areas such as digital engineering and measuring, control and regulation were to be accorded greater attention.

The employers and the union agreed on a concept with the four trainee occupations named above.
Parallel to the Regulations concerning Vocational Training for Occupations in Industrial Electrics/Electronics and the Occupation of Communications Fitter in the Federal Postal Administration, the Standing Conference of Land Education Ministers developed the related general syllabi for the part-time vocational schools (schools and hence vocational schools fall under the purview of the individual Lands in Germany). The Regulations and the general syllabi were brought into line with one another in terms of subject matter and time schedules.

The New Notion of Qualification

In its research work to develop the new regulations for electrics/electronics and metal-working occupations of 1987, the Federal Institute for Vocational Training introduced a new concept of qualification.

In order to anchor the goals of skilled worker training - enabling them to perform changing skilled tasks in different companies and branches and to further develop their professional qualifications - in the regulations, they were premised on the following notion of qualification:

- Qualification is understood to mean the individual ability to perform skilled activities that require independent planning, execu-

tion and control. This definition comprises the following components:

- The reference point for qualification are professional activities, i.e. the subject matter to be imparted must enable the trainee to perform professional activities. The corollary of this is that subject matter is only imparted to the degree needed for the performance of professional activities.

- The ability to perform such activities is premised on skills and knowledge being applied in an integrated way. In formulating the qualifications, therefore, the concern was to integrate skills and knowledge components. This was intended to ensure that knowledge - divorced from professional activity - did not become an end it itself.

- As opposed to simple or multiple activities, skilled professional activities require planning and control in addition to execution. The skilled worker should be able to conduct this execution, planning and control independently. Independent planning here relates to skilled worker level, i.e. the qualifications referred to are:

  Interpretation of technical drawings, circuit diagrams and other technical documents with regard to function and work sequences

  Selection of materials, spare parts, tools and testing equipment, the addition of missing parameters with regard to the objective of the activity (e.g. determining of line and component layouts) within the skilled worker's scope of action

  Allocating materials, spare parts, tools and testing equipment and planning his/her own work sequence and coordinating this with others

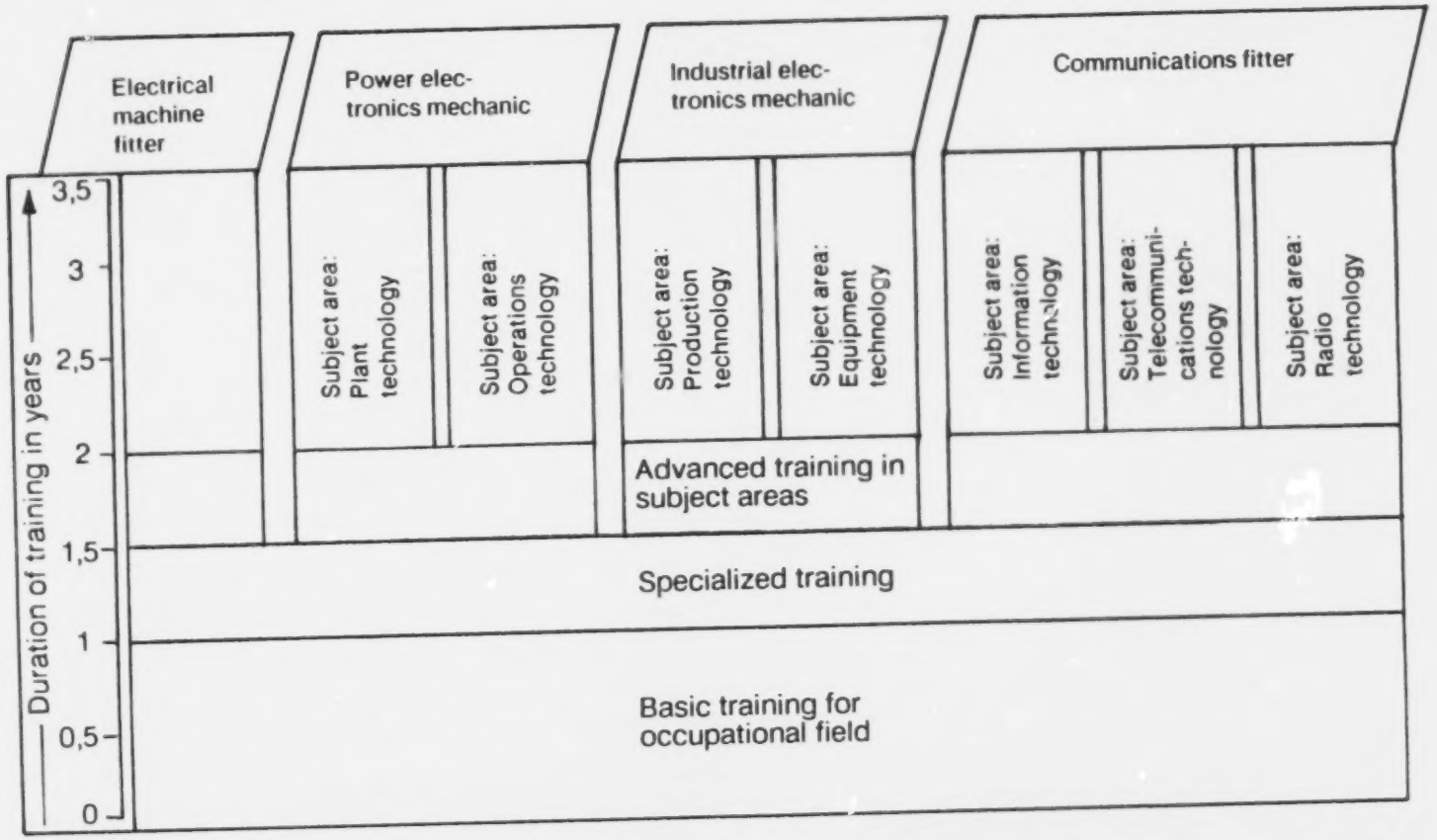
Defining the qualification thus in the general syllabi ensures that the knowledge imparted is directly related to the practical tasks the skilled worker is required to perform and that the scope and level of this knowledge is clearly defined. It also encourages companies to impart skills and knowledge in context.

In the description of the subject matter, the wording is not confined to a specific technology and is aligned to function, i.e. wherever possible, specific machinery, equipment and operating materials are not specified. This open-ended approach permits the optimum choice of training methods and work activities as well as machinery, equipment and operating materials for imparting the qualification aimed at in keeping with the company conditions and the individual abilities of the trainee. By deliberately alternating the

objects and conditions of work, the training qualifies the skilled worker to cope with different, changing working situations and perform different activities in different companies and branches.

10

Chart: Structure of Vocational Training for Industrial Occupations in Electrics/Electronics



II

Occupations in Industrial Electrics / Electronics

in the Federal Republic of Germany

ELECTRICAL MACHINE FITTER

Duration of vocational training: 3½ years

Descriptions

Occupation Profile: On the basis of his / her vocational training, the electrical machine fitter is qualified to perform work assignments in the area of electrical machinery.

Their tasks involve producing, assembling, checking, controlling, setting up, starting up and maintaining electrical machinery: direct-current and alternating-current machinery as well as transformers. They also set up and monitor winding, insulating and taping machinery.

These tasks are performed independently, largely in production and testing, in operational maintenance, construction sites and in service workshops while observing the relevant laws, safety regulations, documents and instructions.

OCCUPATION PROFILE IN BRIEF

with Standard Times from the General Syllabus

Skills and Knowledge in	Standard Times weeks for Year 1.	2	3/4
Basic vocational training, corporate structure and organization of training enterprise, labour and wage law, job protection, health and safety at work, environmental protection, data protection and rational energy utilization	*	*	*
Fabricating mechanical parts	8		
Producing mechanical connections	2		
Assembling and wiring mechanical, electro-mechanical and electrical components to modules	10		
Preparing, laying and connecting lines to terminals	10		
Measuring zero-frequency alternating-frequency quantities and checking components and modules	10		
In-depth treatment of basic vocational training	12		
Assembling and wiring mechanical, electro-mechanical and electrical modules and units		9	
Mounting and installing functionally demarcated plant sections		9	
Testing, measuring and setting modules and units		6	
Starting up modules, units and functionally demarcated plant sections		2	
Fabricating mechanical components and modules for electrical machinery		8	
Fabricating windings for electrical machinery		14	
Assembling and wiring controllers, regulators and monitoring equipment		4	
Installing windings in operative and non-operative electrical machinery and connecting the windings to circuits			18
Assembling and dismantling electrical machinery			14
Installing electrical machinery and units in drive and power plants			12
Setting up and supervising production installations for electrical machinery			4
Testing, measuring and setting electrical machinery and related units			14
Starting up electrical machinery and related units			8
Maintaining electrical machinery and related units			8
	52	52	78

* To be imparted during the entire training period

POWER ELECTRONICS MECHANIC

Specialization: Plant Technology

Duration of vocational training: 3½ years

Descriptions

Occupation Profile: On the basis of his/her vocational training, the power electronics mechanic in the specialized subject area of plant technology is qualified to perform work assignments in the area of electrical power engineering.

Their tasks involve mounting, installing, starting up and servicing power plant, controllers, regulators and drives, signalling and lighting equipment.

These tasks are performed independently at different locations, largely on construction sites, in assembly shops or in service areas while observing the relevant laws, safety regulations, documents and instructions.

OCCUPATION PROFILE IN BRIEF

with Standard Times from the General Syllabus

Skills and Knowledge in	Standard Times weeks for Year 1	2	3/4
Basic vocational training, corporate structure and organization of training enterprise, labour and wage law, job protection, health and safety at work, environmental protection, data protection and rational energy utilization	*	*	*
Fabricating mechanical parts	8		
Producing mechanical connections	2		
Assembling and wiring mechanical and electro-mechanical and electrical components to modules	10		
Preparing, laying and connecting lines to terminals	10		
Measuring zero-frequency alternating-frequency quantities and checking components and modules	10		
In-depth treatment of basic vocational training	12		
Assembling and wiring mechanical and electro-mechanical and electrical modules and units		9	
Mounting and installing functionally demarcated plant sections		9	
Testing, measuring and setting modules and units		13	
Starting up modules, units and functionally demarcated plant sections		5	
Assembling, wiring, mounting and installing power modules and plant sections		16	
Assembling and wiring modules and units in circuitry, controllers and distributors			12
Preparing and concluding mounting work			4
Mounting lines, cables and installation systems			18
Mounting and installing operating materials and plant for power distribution, controllers, signalling and lighting equipment as well as electrical machinery and servo units			20
Measuring non-electric quantities and checking function of stored-programme controllers			8
Commissioning operating equipment and plant for power distribution, controllers, signalling and lighting equipment as well as electrical machinery and servo units			10
Maintaining power operating equipment and plant			6
	52	52	78

* To be imparted during the entire training period

POWER ELECTRONICS MECHANIC

Specialization: Operations Technology

Duration of vocational training: 3½ years

Descriptions

Occupation Profile: On the basis of his/her vocational training, the power electronics mechanic in the specialized subject area of operations technology is qualified to perform work assignments in the area of electrical power engineering.

Their tasks involve setting up, extending and altering, starting up and maintaining power plant and meters, controllers and regulators and drives as well as signalling equipment.

These tasks are performed independently largely on operating plant and operational maintenance while observing the relevant laws, safety regulations, documents and instructions.

OCCUPATION PROFILE IN BRIEF

with Standard Times from the General Syllabus

Skills and Knowledge in	Standard Times weeks for Year 1	2	3/4
Basic vocational training, corporate structure and organization of training enterprise, labour and wage law, job protection, health and safety at work, environmental protection, data protection and rational energy utilization.	*	*	*
Fabricating mechanical parts	8		
Producing mechanical connections	2		
Assembling and wiring mechanical and electro-mechanical and electrical components to modules	10		
Preparing, laying and connecting lines to terminals	10		
Measuring zero-frequency alternating-frequency quantities and checking components and modules	10		
In-depth treatment of basic vocational training	12		
Assembling and wiring mechanical and electro-mechanical and electrical modules and units		9	
Mounting and installing functionally demarcated plant sections		9	
Testing, measuring and setting modules and units		13	
Starting up modules, units and functionally demarcated plant sections		5	
Assembling, wiring, mounting and installing power modules and plant sections		16	
Assembling and wiring operating equipment and switchgear for power plant			12
Mounting and installing power plant			14
Measuring non-electric quantities and testing functions of meters, controllers and regulators			18
Starting up power plant			8
Maintaining distributors, lighting and signalling, equipment, controllers, regulators and drives			26
	52	52	78

* To be imparted during the entire training period

INDUSTRIAL ELECTRONICS MECHANIC

Specialization: Production Technology

Duration of vocational training: 3½ years

Descriptions

Occupation Profile: On the basis of his/her vocational training, the industrial electronics mechanic in the specialized subject area of production technology is qualified to perform work assignments in the area of automated manufacture and quality testing.

Their tasks involve outfitting, recomissioning, monitoring and maintaining automated equipment to manufacture products and test their quality. They locate the causes of malfunctions and eliminate them by replacing modules.

These tasks are performed independently largely in manufacturing and quality testing while observing the relevant laws, safety regulations, documents and instructions.

20

OCCUPATION PROFILE IN BRIEF

with Standard Times from the General Syllabus

Skills and Knowledge in	Standard Times weeks for Year 1	2	3/4
Basic vocational training, corporate structure and organization of training enterprise, labour and wage law, job protection, health and safety at work, environmental protection, data protection and rational energy utilization	*	*	*
Fabricating mechanical parts	8		
Producing mechanical connections	2		
Assembling and wiring mechanical and electro-mechanical and electrical components to modules	10		
Preparing, laying and connecting lines to terminals	10		
Measuring zero-frequency alternating-frequency quantities and checking components and modules	10		
In-depth treatment of basic vocational training	12		
Assembling and wiring mechanical and electro-mechanical and electrical modules and units		23	
Mounting and installing functionally demarcated plant sections		9	
Testing, measuring and setting modules and units		12	
Starting up modules, units and functionally demarcated plant sections		8	
Mounting automated production installations			22
Setting up and monitoring automated production installations			20
Testing, measuring, setting and aligning functional and process sequences on automated production installations			14
Recommissioning units and automated production installations			10
Maintaining automated production installations			12
	52	52	78

* To be imparted during the entire training period

21

INDUSTRIAL ELECTRONICS MECHANIC

Specialization: Equipment Technology

Duration of vocational training: 3½ years

Descriptions

Occupation Profile: On the basis of his/her vocational training, the industrial electronics mechanic in the specialized subject area of equipment technology is qualified to perform work assignments in the area of electrical equipment.

Their tasks involve manufacturing, testing, starting up and maintaining power or communications units and modules.

These tasks are performed independently, largely in manufacturing, quality testing, testing equipment manufacture and test workshops while observing the relevant laws, safety regulations, documents and instructions.

22

OCCUPATION PROFILE IN BRIEF

with Standard Times from the General Syllabus

Skills and Knowledge in	Standard Times weeks for Year 1	2	3/4
Basic vocational training, corporate structure and organization of training enterprise, labour and wage law, job protection, health and safety at work, environmental protection, data protection and rational energy utilization.	*	*	*
Fabricating mechanical parts	8		
Producing mechanical connections	2		
Assembling and wiring mechanical and electro-mechanical and electrical components to modules	10		
Preparing, laying and connecting lines to terminals	10		
Measuring zero-frequency alternating-frequency quantities and checking components and modules	10		
In-depth treatment of basic vocational training	12		
Assembling and wiring mechanical and electro-mechanical and electrical modules and units		23	
Mounting and installing functionally demarcated plant sections		9	
Testing, measuring and setting modules and units		12	
Starting up modules, units and functionally demarcated plant sections		8	
Fabricating mechanical parts on machine tools			4
Fabricating electro-mechanical and electrical components			10
Fabricating inserting components into printed circuit boards			6
Assembling and wiring power or communications modules and units			26
Testing, measuring, setting and aligning modules and units			15
Starting up modules and units			5
Maintaining modules and units			12
	52	52	78

* To be imparted during the entire training period

COMMUNICATIONS FITTER

Specialization: Information Technology

Duration of vocational training: 3½ years

Descriptions

Occupation Profile: On the basis of his/her vocational training, the communications fitter in the specialized subject area of information technology is qualified to perform work assignments in the area of information and data technology.

Their tasks involve manufacturing, testing, measuring, adjusting, starting up and maintaining information/data units, plant and systems, including output/input, data processing and transfer and the related controllers and regulators.

These tasks are performed independently, largely in manufacturing, quality testing, testing departments, testing equipment manufacture, development and test workshops, customer service, operational maintenance and in the assembly of plant and systems while observing the relevant laws, safety regulations, documents and instructions.

OCCUPATION PROFILE IN BRIEF

with Standard Times from the General Syllabus

Skills and Knowledge in	Standard Times weeks for Year 1	2	3/4
Basic vocational training, corporate structure and organization of training enterprise, labour and wage law, job protection, health and safety at work, environmental protection, data protection and rational energy utilization.	*	*	*
Fabricating mechanical parts	8		
Producing mechanical connections	2		
Assembling and wiring mechanical and electro-mechanical and electrical components to modules	10		
Preparing, laying and connecting lines to terminals	10		
Measuring zero-frequency alternating-frequency quantities and checking components and modules	10		
In-depth treatment of basic vocational training	12		
Assembling and wiring mechanical and electro-mechanical and electrical modules and units		9	
Mounting and installing functionally demarcated plant sections		9	
Testing, measuring and setting modules and units		13	
Starting up modules, units and functionally demarcated plant sections		4	
Assembling, wiring, mounting and installing communications modules, units or plant sections		9	
Localizing, identifying and eliminating faults in communications units or functionally demarcated plant sections		4	
Operating data processing units and applying programmes		4	
Assembling, wiring, mounting and installing information and data modules, units and plant			20
Testing, measuring, setting and aligning information and data modules, units and plant			20
Starting up information and data units and plant			22
Maintaining information and data units and plant			16
	52	52	78

* To be imparted during the entire training period

25

COMMUNICATIONS FITTER

Specialization: Telecommunications Technology

Duration of vocational training: 3½ years

Descriptions

Occupation Profile: On the basis of his/her vocational training, the communications fitter in the specialized subject area of telecommunications technology is qualified to perform work assignments in the area of telecommunications for languages, data, text and image as well as in signalling technology.

Their tasks involve constructing, installing, mounting, testing, starting up, operating and servicing telecommunications units, plant and systems and signalling technology, including transmission paths.

These tasks are performed independently, largely at changing locations, largely in assembly, start-up, servicing or operational maintenance while observing the relevant laws, safety regulations, documents and instructions.

Communications fitters in the specialized subject area of telecommunications technology are trained in industrial establishments in the Federal Postal Administration (public service).

OCCUPATION PROFILE IN BRIEF

with Standard Times from the General Syllabus

Skills and Knowledge in	Standard Times weeks for Year 1	2	3/4
Basic vocational training, corporate structure and organization of training enterprise, labour and wage law, job protection, health and safety at work, environmental protection, data protection and rational energy utilization.	*	*	*
Fabricating mechanical parts	8		
Producing mechanical connections	2		
Assembling and wiring mechanical and electro-mechanical and electrical components to modules	10		
Preparing, laying and connecting lines to terminals	10		
Measuring zero-frequency alternating-frequency quantities and checking components and modules	10		
In-depth treatment of basic vocational training	12		
Assembling and wiring mechanical and electro-mechanical and electrical modules and units		9	
Mounting and installing functionally demarcated plant sections		9	
Testing, measuring and setting modules and units		13	
Starting up modules, units and functionally demarcated plant sections		4	
Assembling, wiring, mounting and installing communications modules, units or plant sections		9	
Localizing, identifying and eliminating faults in communications units or functionally demarcated plant sections		4	
Operating data processing units and applying programmes		4	
Assembling and wiring components to units and mounting, installing and extending tele-communications plant			24
Testing, measuring, setting and adjusting telecommunications modules, units and plant			9
Starting up telecommunications units and plant			14
Maintaining telecommunications units and plant			18
Operating telecommunications units and plant			13
	52	52	78

* To be imparted during the entire training period

27

COMMUNICATIONS FITTER

Specialization: Radio Technology

Duration of vocational training: 3½ years

Descriptions

Occupation Profile: On the basis of his/her vocational training, the communications fitter in the specialized subject area of radio technology is qualified to perform work assignments in the area of radio technology, including transmitters, receivers, transmission technology and radar.

Their tasks involve fabricating, testing, starting up and maintaining radio units, plant and systems, such as transmitters and receivers, including aerials, recorders and reproducers for sound and vision, high and low frequency transmission units and systems and radar measuring units and plant.

These tasks are performed independently, largely in manufacturing, quality control, in test departments and testing equipment manufacture, in development and test workshops, customer service, operational maintenance and in the assembly of plant and systems while observing the relevant laws, safety regulations, documents and instructions.

OCCUPATION PROFILE IN BRIEF

with Standard Times from the General Syllabus

Skills and Knowledge in	Standard Times weeks for Year 1	2	3/4
Basic vocational training, corporate structure and organization of training enterprise, labour and wage law, job protection, health and safety at work, environmental protection, data protection and rational energy utilization.	*	*	*
Fabricating mechanical parts	8		
Producing mechanical connections	2		
Assembling and wiring mechanical and electro-mechanical and electrical components to modules	10		
Preparing, laying and connecting lines to terminals	10		
Measuring zero-frequency alternating-frequency quantities and checking components and modules	10		
In-depth treatment of basic vocational training	12		
Assembling and wiring mechanical and electro-mechanical and electrical modules and units		9	
Mounting and installing functionally demarcated plant sections		9	
Testing, measuring and setting modules and units		13	
Starting up modules, units and functionally demarcated plant sections		4	
Assembling, wiring, mounting and installing communications modules, units or plant sections		9	
Localizing, identifying and eliminating faults in communications units or functionally demarcated plant sections		4	
Operating data processing units and applying programmes		4	
Assembling and wiring components and mounting and installing radio modules, units and plant			10
Testing, measuring, setting and adjusting radio modules, units and plant			26
Starting up radio units and plant			20
Maintaining radio modules, units and plant			22
	52	52	78

* To be imparted during the entire training period

REGULATIONS CONCERNING VOCATIONAL TRAINING FOR OCCUPATIONS IN INDUSTRIAL ELECTRICS/ELECTRONICS AND THE OCCUPATION OF COMMUNICATIONS FITTER IN THE FEDERAL POSTAL ADMINISTRATION*

OF 15 JANUARY 1987

By virtue of section 25 of the Vocational Training Act of 14 August 1969 (BGBl. I p. 1112), last amended by para. 1 of section 24 of the Act of 24 August 1976 (BGBl. I p. 2525),

- with regard to Part I, the Federal Minister of Economics and
- with regard to Part II, the Federal Minister of Posts and Telecommunications,

acting in agreement with the Federal Minister of Education and Science, hereby order the following:-

Part I

Vocational Training for Occupations in Industrial Electrics/Electronics

Section 1

Government Recognition of Trainee Occupations, Specialized Subject Areas

(1) The following trainee occupations are hereby officially recognized:

electrical machine fitter,
power electronics mechanic,
industrial electronics mechanic,
communications fitter.

(2) Training may be imparted in the following specialized subject areas:-

1. for the trainee occupation of power electronics mechanic in
   a) plant technology,
   b) operations technology;
2. for the trainee occupation of industrial electronics mechanic in
   a) production technology,
   b) instrument technology;
3. for the trainee occupation of communications fitter in
   a) information technology,
   b) telecommunications technology,
   c) radio technology.

(3) The designation of the specialized subject area shall be employed in addition to the title of the trainee occupation

Section 2

Duration of Training

(1) The training shall normally last three and a half years.

(2) Trainees to be granted credit for the school-based basic vocational training year introduced in terms of the legislation of the Land concerned in accordance with a statutory order pursuant to subsection (I) of section 29 of the Vocational Training Act shall commence in-plant training in the second training year.

Section 3

Basic Training covering Occupational Field, Structure and Purpose of Initial Training

(1) The training in the first year shall impart basic training covering the occupational field, provided the in-plant training is imparted in accordance with these Regulations and the training in the part-time vocational school is imparted in accordance with the legal provisions of the Land concerned governing the basic vocational training year.

(2) In the second training year, the specialized training subject matter in the first half-year is the same for all occupations and in the second half-year, the specialized training differs according to occupation.

(3) In trainee occupations with specialized subject areas, a third training year follows, in which specialized training is imparted according to the different specialized subject areas.

(4) The skills and knowledge stipulated in these Regulations shall be imparted in such a way as to enable the trainee in terms of subsection (2) of section 1 of the Vocational Training Act to perform a skilled occupational activity, to include in particular independent planning, execution and control. The instruction shall be geared to the requirements of the occupation and its respective specialized subject area. Trainees shall also be required to demonstrate the qualifications described in sentence 1 in the respective examinations.

Section 4

Occupation Profile for Electrical Machine Fitter

(1) The initial training shall encompass at least the following skills and knowledge:-

1. vocational training,
2. structure and organization of the training enterprise,

* This statutory order is a training ordinance within the meaning of section 25 of the Vocational Training Act. The Regulations and the General Syllabus for vocational schools adopted by the Standing Conference of Land Education Ministers and harmonized with it will be published shortly as Annexe to the Federal Gazette.

BEST COPY AVAILABLE

3. labour legislation and legislation on wages and safety and health at work,

4. industrial safety, environmental protection, data protection and rational use of energy,

5. fabricating mechanical parts,

6. producing mechanical connections,

7. assembling and wiring of mechanical, electromechanical and electric components to form modules,

8. preparing, laying and connecting lines,

9. measuring of zero-frequency and alternating quantities and checking of components and modules,

10. assembling and wiring of mechanical, electromechanical and electric modules and units,

11. mounting and installing functionally demarcated plant sections,

12. checking, measuring and setting modules and units,

13. commissioning modules, units and functionally demarcated plant sections,

14. fabricating mechanical components and modules for electric machines,

15. fabricating windings for electric machines,

16. assembling and wiring of controllers, regulators and monitoring equipment,

17. installing windings in operative and non-operative electric machines and connecting the windings,

18. mounting and dismantling electric machines,

19. installing electric machines and units in drive and power supply plant,

20. setting up and supervising production installations for electric machines,

21. checking, measuring and setting on electric machines and related units,

22. commissioning electric machines and related units,

23. maintaining electric machines and related units.

Section 5

Occupation Profile for Power Electronics Mechanic

(1) The initial training shall encompass at least the following skills and knowledge:-

1. vocational training,

2. structure and organization of the training enterprise,

3. labour legislation and legislation on wages and safety and health at work,

4. industrial safety, environmental protection, data protection and rational use of energy,

5. fabricating mechanical parts,

6. producing mechanical connections,

7. assembling and wiring of mechanical, electromechanical and electric components to form modules,

8. preparing, laying and connecting lines,

9. measuring of zero-frequency and alternating quantities and checking of components and modules,

10. assembling and wiring of mechanical, electromechanical and electric modules and units,

11. mounting and installing functionally demarcated plant sections,

12. checking, measuring and setting modules and units,

13. commissioning modules, units and functionally demarcated plant sections,

14. assembling, wiring, mounting and installing power supply modules and plant sections.

(2) The initial training in the specialized subject areas shall encompass at least the following skills and knowledge:

1. in the specialized subject area of production technology:-

   a) assembling and wiring switching, control and distribution modules and units,

   b) preparing and completing mounting work,

   c) mounting of lines, cables and installation systems,

   d) mounting and installing power distribution, control, signal and lighting systems as well as electric machines and servo units,

   e) measuring non-electric values and checking function of stored-programme controllers,

   f) commissioning power distribution, control, signalling and lighting plant and electric machines and servo units,

   g) maintaining power supply plant;

2. in the specialized subject area of operations technology:-

   a) assembling and wiring operating equipment and switchgear for power plant,

   b) mounting and installing power supply operating equipment and plant,

   c) measuring non-electric values and checking functions of measuring equipment, controllers and regulators,

   d) recommissioning power supply operating equipment and plant,

   e) maintaining power distribution, lighting, signaling, control and drive operating equipment and plant

Section 6

Occupation Profile for Industrial Electronics Mechanic

(1) The initial training shall encompass at least the following skills and knowledge:-

1 vocational training,

2 structure and organization of the training enterprise,

3 labour legislation and legislation on wages and safety and health at work,

4 industrial safety, environmental protection, data protection and rational use of energy,

5 fabricating mechanical parts,

6 producing mechanical connections,

7 assembling and wiring of mechanical, electromechanical and electric components to form modules,

8 preparing, laying and connecting lines,

9 measuring of zero-frequency and alternating quantities and checking of components and modules,

10 assembling and wiring of mechanical, electromechanical and electric modules and units,

11 mounting and installing functionally demarcated plant sections,

12 checking, measuring and setting modules and units,

13 commissioning modules, units and functionally demarcated plant sections,

(2) The initial training in the specialized subject areas shall encompass at least the following skills and knowledge:-

1 in the specialized subject area of production technology:-

a) mounting automated production equipment,

b) setting up and supervising automated production equipment,

c) checking, measuring, setting and adjusting function and process flows in automated production equipment,

d) recommissioning units and automated production equipment,

e) maintaining automated production equipment;

2 in the specialized subject area of instrument technology:-

a) fabricating mechanical parts on machine tools,

b) fabricating of electromechanical and electric components,

c) fabricating and inserting components into printed circuit boards,

d) assembling and wiring power supply and communications modules and units,

e) checking, measuring, setting and adjusting modules and units,

f) commissioning modules and units,

g) maintaining modules and units.

Section 7

Occupation Profile for Communications Fitter

(1) The initial training shall encompass at least the following skills and knowledge:-

1. vocational training,

2. structure and organization of the training enterprise,

3. labour legislation and legislation on wages and safety and health at work,

4. industrial safety, environmental protection, data protection and rational use of energy,

5. fabricating mechanical parts,

6. producing mechanical connections,

7. assembling and wiring of mechanical, electromechanical and electric components to form modules,

8. preparing, laying and connecting lines,

9. measuring zero-frequency and alternating quantities and checking of components and modules,

10. assembling and wiring of mechanical, electromechanical and electric modules and units,

11. mounting and installing functionally demarcated plant sections,

12. checking, measuring and setting modules and units,

13. commissioning modules, units and functionally demarcated plant sections,

14. assembling, wiring, mounting and installing communications modules, units or plant sections,

15. localizing, identifying and rectifying faults in communications units or functionally demarcated plant sections,

16. Operating data processing units and applying programmes.

(2) The initial training in the specialized subject areas shall encompass at least the following skills and knowledge:-

1. In the specialized subject area of information technology:-

   a) assembling, wiring, mounting and installing information and data processing modules, units and plant,

   b) checking, measuring, setting and adjusting on information and data processing modules, units and plant,

   c) commissioning information and data processing units and plant,

   d) maintaining information and data processing units and plant,

2. In the specialized subject area of telecommunications technology:-

   a) assembling and wiring telecommunications modules, units and plant,

b) checking, measuring, setting and adjusting telecommunications modules, units and plant,

c) commissioning telecommunications units and plant,

d) maintaining telecommunications units and plant,

e) operating telecommunications units and plant;

3. in the specialized subject area of radio technology:-

a) assembling, wiring, mounting and installing radio modules, units and plant,

b) checking, measuring, setting and adjusting radio modules, units and plant,

c) commissioning radio units and plant,

d) maintaining radio units and plant.

Section 8

General Syllabuses

The skills and knowledge stipulated in sections 4 to 7 shall be imparted according to the guidelines on subject matter and timetables contained in the Annexes 1 to 4 for basic training and specialized training (General Syllabuses). The organization of subject matter and timetables for the training content pertaining to basic training and specialized training may exceptionally deviate from that specified in the General Syllabus where this is required by specific operational practice.

Section 9

Syllabus

The training employer shall devise a syllabus for the trainee based on the General Syllabus.

Section 10

Report Book

The trainee shall keep a report book in the form of a training document. He shall be provided with the opportunity to enter the relevant particulars into the record book during the period of training. The training employer shall regularly inspect the report book.

Section 11

Interim Examination

(1) An interim examination shall be set to ascertain the level the trainee has attained. It shall be held before the end of the second training year.

(2) The interim examination shall in accordance with subsection (4) of section 3 comprise the skills and knowledge stipulated in Annexes 1 to 4 in Part I and Part II under serial No. 1a) to 1h), No. 2 and No. 3a) to 3k) and No. 4a) to 4g) as well as the subject matter to be imparted in part-time vocational schools in accordance with the General Syllabuses, provided this is pertinent to initial training.

(3) Based on technical documents, the examination candidate shall be required to fabricate a functional module as a test piece in a maximum of seven hours with particular attention to be paid to the following:

1. drawing up a work schedule,
2. fabricating a mechanical component,
3. assembling and wiring mechanical, electromechanical and electric components,
4. preparing, wiring and connecting lines,
5. checking functionality and measuring operating characteristics,
6. drawing up test and calibration records.

(4) For a maximum of 180 minutes, the examination candidate shall be required to give written solutions to tasks that shall be related to practical cases from the following areas:

1. safety at work and environmental protection,
2. materials and materials processing,
3. basic electronics,
4. basic circuitry,
5. basic measurement technique.

(5) The duration of the examination specified in subsection (4) may be shortened provided the written examination is conducted in programmed form.

Section 12

Final Examination for the Trainee Occupation of Electrical Machine Fitter

(1) The final examination shall encompass the skills and knowledge listed in Annexe 1 subject to subsection (4) of section 3 and the subject matter imparted in part-time vocational schools, provided this is pertinent to initial training.

(2) The examination candidate shall fabricate two test pieces in a maximum of ten hours and complete three work tests in a maximum of four hours, with particular attention to be paid to the following:

1. as test pieces:

a) install prefabricated coils in a three-phase or direct current machine and switches for a stator or rotor winding according to circuit diagrams in a maximum of seven hours,

b) fabricate a mechanical component and install it in a prescribed module for electric machines and related units;

2. as work tests:

a) set up production equipment and fabricate electromechanical and electric components for electric machines, in particular set up a winding machine sketch a winding diagram and fabricate and fit a pattern coil with related insulation,

b) conduct insulation measurements, high voltage tests, set up and connect an electric machine conduct a test run and draw up a record,

c) identify, localize and rectify faults or malfunctions in electric machines and related measurement control and regulation modules and units,

The test pieces together shall be accorded 60 per cent of the marks as compared to 40 per cent for the work tests.

(3) The examination candidate shall be required to sit a written examination in the subjects technology, circuit and function analysis, technical mathematics and economics and social studies. In the examination subject circuit and function analysis, technical problems are to be analyzed and assessed, linking informational, technological and mathematical tasks and appropriate solutions presented. Tasks posed shall relate to practical situations, particularly from the following areas:-

1 in the examination subject technology:

describe and present constructional forms, properties, characteristics and typical areas of application for construction elements and the structure, mode of operation, functions and typical applications of electric machines and modules, units and plant sections in the following areas:

a) control technology,

b) power technology,

c) drive technology,

d) protective equipment and measures;

2 in the examination subject circuit and function analysis:

a) analyze the functions of electric machines and related control and monitoring units based on prescribed circuit diagrams, data sheets and programmes, ascertain and present electric and non-electric quantities, sequences and interconnections and assess the effects of prescribed actions and give reasons for these,

b) select and sketch suitable circuits based on documents for prescribed typical measurement and test procedures on electric machines and related control and monitoring units, give reasons for the selection of the units and ascertain and assess possible measuring errors dependent on units and circuits,

c) ascertain components, lines and working units needed for the fabrication of coils and windings and the mounting of electric machines and related control and monitoring units and sketch and supplement circuit and winding diagrams and component and circuit layouts based on technical documents;

3 in the examination subject technical mathematics:

ascertain and present electric quantities and electric and mechanical characteristics from the areas:

a) equiphase and single-phase alternating circuits,

b) polyphase alternating circuits,

c) winding technique,

d) electric machines,

e) drive technology;

4 in the examination subject economics and social studies:

general economic and social conditions affecting occupation and work;

(4) The maximum times for the written examination shall be as follows:

1.	in the examination subject technology	120 minutes,
2.	in the examination subject circuit and function analysis	120 minutes,
3.	in the examination subject technical mathematics	60 minutes,
4.	in the examination subject economics and social studies	60 minutes

(5) The examination duration stipulated in subsection (4) may exceptionally be shortened, provided the written examination is conducted in programmed form.

(6) On request of the candidate or if deemed appropriate by the examining board, the written examination in individual subjects may be supplemented by an oral examination, where this may be decisive for a pass or fail. The written examination shall be allotted twice as many marks as compared to the oral examination.

(7) In the written examination, the examination subject technology shall be allotted twice as many marks as compared to each of the other examination subjects.

(8) A candidate shall be deemed to have passed the examination when he or she has obtained at least the grade 'adequate' in both the practical and written examinations as well as in the examination subject technology in the written examination.

Section 13

Final Examination for the Trainee Occupation of Power Electronics Mechanic

(1) The final examination shall encompass the skills and knowledge listed in Annexe 2 subject to subsection (4) of section 3 and the subject matter imparted in part-time vocational schools, provided this is pertinent to initial training.

(2) The examination candidate shall be required to perform the following operations in a total of 14 hours:

1. In the examination subject plant technology:

fabricate a test piece in a maximum of 7 hours and conduct four work tests in a maximum of 7 hours, with particular attention to be paid to the following:

a) as a test piece:

mount, install and test a functionally demarcated power distribution, control, signalling or lighting plant section using circuit diagrams with due attention to safety regulations and protective measures,

b) as work tests:

aa) alter or supplement and commission a control, drive, signalling or lighting plant section,

bb) select the measuring equipment, construct a measuring setup, measure electric quantities and draw up a calibration record,

cc) test, set and adjust a power plant section including safety and protective equipment,

BEST COPY AVAILABLE

dd) identify, localize and rectify faults or malfunctions in a power distribution, control, signalling and lighting plant section.

The test pieces together shall be accorded 60 per cent of the marks as compared to 40 per cent for the work tests.

2. in the specialized subject area operations technology:

fabricate a test piece in a maximum of 6 hours and conduct 4 work tests in a maximum of 8 hours, particular attention to be paid to the following:

a) as test piece:

mount, install and test, control, drive, or signalling operating equipment or functionally demarcated plant section using circuit documents with due attention to safety regulations and protective measures,

b) as work tests:

aa) alter or supplement and commission control, drive, signalling or lighting operating equipment or plant section,

bb) select the measuring equipment, construct a, measurement setup, measure electric quantities and draw up a calibration record,

cc) test, set and adjust operating equipment or a power plant section including safety or protective equipment,

dd) identify, localize and rectify faults or malfunctions in a measuring, control and drive plant section,

The test piece shall be accorded 40 per cent of the marks as compared to 60 per cent for the work tests as a whole.

(3) The examination candidate shall be required to sit a written examination in the subjects technology, circuit and function analysis, technical mathematics and economics and social studies. In the examination subject circuit and function analysis, technical problems are to be analyzed and assessed, linking informational, technological and mathematical tasks and appropriate solutions presented. Tasks posed shall relate to practical situations, particularly from the following areas:-

1. in the specialized subject area plant technology:

a) in the examination subject technology:

describe and present constructional forms, properties, characteristics and typical areas of application for construction elements and the structure, mode of operation, functions and typical applications of modules, units and plant sections in the following areas:

aa) electric machines,

bb) control technology,

cc) power technology,

dd) electric plant and protective measures,

ee) automation technology;

b) in the examination subject circuit and function analysis:

aa) analyze the functions power distribution, control, signalling or lighting modules, units or plant sections based on prescribed circuit diagrams, data sheets and programmes, ascertain and present electric and non-electric quantities, sequences and interconnections and assess the effects of prescribed actions and give reasons for these,

bb) select and sketch suitable circuits based on documents for prescribed typical measurement and test procedures on electric plant, give reasons for the selection of the units and ascertain and assess possible measuring errors dependent on units and circuits,

cc) ascertain components, lines and other materials needed to mount plant, specify requisite tools and working equipment and sketch component and circuit layouts based on technical documents;

c) in the examination subject technical mathematics:

ascertain and present electric quantities and characteristics from the following areas:

aa) equiphase and single-phase alternating current circuits,

bb) single-phase and polyphase systems,

cc) control technology,

dd) electric plant,

ee) protective equipment and measures;

d) in the examination subject economics and social studies:

general economic and social conditions affecting occupation and work;

2. in the examination subject operations technology:

a) in the examination subject technology:

describe and present constructional forms, properties, characteristics and typical areas of application for construction elements and the structure, mode of operation, functions and typical applications of modules, units and plant sections in the following areas:

aa) electric machines,

bb) control technology,

cc) power technology,

dd) electric plant and protective measures,

ee) automation technology;

b) in the examination subject circuit and function analysis:

aa) analyze the functions of measuring, control and drive modules, units or plant sections based on prescribed circuit diagrams, data sheets and programmes, ascertain and pre-

BEST COPY AVAILABLE

sent electric and non-electric quantities, sequences and interconnections and assess the effects of prescribed actions and give reasons for these,

bb) select and sketch suitable circuits based on documents for prescribed typical measurement and test procedures as part of maintenance work on electric plant, give reasons for the selection of the units and ascertain and assess possible measuring errors dependent on units and circuits,

cc) ascertain components, lines and other materials needed to extend measuring, control and drive plant, specify requisite tools and working equipment and sketch component and circuit layouts based on technical documents;

c) in the examination subject technical mathematics:

ascertain and present electric quantities and characteristics from the following areas:

aa) equiphase and single-phase alternating current circuits,

bb) single-phase and polyphase systems,

cc) control technology,

dd) electric plant,

ee) protective equipment and measures;

d) in the examination subject economics and social studies:

general economic and social conditions affecting occupation and work;

(4) The maximum times for the written examination shall be as follows:

1	in the examination subject technology	120 minutes,
2	in the examination subject circuit and function analysis	120 minutes,
3	in the examination subject technical mathematics	60 minutes,
4	in the examination subject economics and social studies	60 minutes

(5) The examination duration stipulated in subsection (4) may exceptionally be shortened, provided the written examination is conducted in programmed form.

(6) On request of the candidate or if deemed appropriate by the examining board, the written examination in individual subjects may be supplemented by an oral examination, where this may be decisive for a pass or fail. The written examination shall be allotted twice as many marks as compared to the oral examination.

(7) In the written examination, the examination subject technology shall be allotted twice as many marks as compared to each of the other examination subjects.

(8) A candidate shall be deemed to have passed the examination when he or she has obtained at least the grade adequate' in both the practical and written examinations as well as in the examination subject technology in the written examination.

Section 14

Final Examination for the Trainee Occupation of Industrial Electronics Mechanic

(1) The final examination shall encompass the skills and knowledge listed in Annexe 3 subject to subsection (4) of section 3 and the subject matter imparted in part-time vocational schools, provided this is pertinent to initial training.

(2) The examination candidate shall be required to perform the following operations in a total of 14 hours:

1. in the examination subject production technology:

fabricate a test piece in a maximum of 4 hours and conduct five work tests in a maximum of 10 hours, with particular attention to be paid to the following:

a) as a test piece

fabricate a control and regulation module according to circuit documents using different wiring and connection methods;

b) as work tests:

aa) identify, localize and rectify faults or malfunctions in electric and pneumatic or hydraulic controllers,

bb) select and construct a measurement setup, measure electric and non-electric quantities and draw up a calibration record,

cc) recommission a unit or production equipment and check the effectiveness of safety, protective and monitoring equipment,

dd) alter operating characteristics of a plant or plant section by setting and adjusting sensor and actuator modules,

ee) alter a control programme for programme controlled modules or units according to documents and check the programme sequence.

The test piece shall be accorded 20 per cent of the marks as compared to 80 per cent for the work tests as a whole.

2. in the specialized subject area instrument technology:

fabricate a test piece in a maximum of 10 hours and conduct 4 work tests in a maximum of 4 hours, particular attention to be paid to the following:

a) as a test piece:

fabricate a functional electric module or a unit according to documents including the fabrication and installation of mechanical parts, insertion of components into printed circuit boards and connection using different wiring and connecting techniques;

b) as work tests

aa) commission a module or a unit including checking function and safety and protective equipment, setting of operating characteristics and drawing up of a record,

bb) test and measure an analogue circuit including the construction of a measurement and test setup and the drawing up of a calibration record,

cc) test and measure a digital circuit including the construction of a measuring and test setup and drawing up a record,

dd) identify, localize and rectify faults or malfunctions in a module or a unit and draw up a record

The test pieces together shall be accorded 60 per cent of the marks as compared to 40 per cent for the work tests.

(3) The examination candidate shall be required to sit a written examination in the subjects technology, circuit and function analysis, technical mathematics and economics and social studies. In the examination subject circuit and function analysis, technical problems are to be analyzed and assessed, linking informational, technological and mathematical tasks and appropriate solutions presented. Tasks posed shall relate to practical situations, particularly from the following areas:-

1. in the specialized subject area production technology:

a) in the examination subject technology:

describe and present constructional forms, properties, characteristics and typical areas of application for construction elements and the structure, mode of operation, functions and typical applications of modules, units and plant sections in the following areas:

aa) protective measures,

bb) control technology,

cc) power technology,

dd) drive technology,

ee) regulators,

ff) measurement technique,

gg) process data processing;

b) in the examination subject circuit and function analysis:

aa) analyze the functions of units and plant sections of automated equipment for manufacture and quality testing of products based on prescribed circuit documents, data sheets and programmes, ascertain and present electric and non-electric quantities, sequences and interconnections and assess the effects of prescribed actions and give reasons for these,

bb) select and sketch suitable circuits based on documents for prescribed typical measurement and test procedures on automated equipment for manufacture and quality testing of products, give reasons for the selection of the units and ascertain and assess possible measuring errors dependent on units and circuits,

c) in the examination subject technical mathematics:

ascertain and present electric quantities and characteristics from the following areas:

aa) equiphase and single-phase alternating current circuits,

bb) single-phase and polyphase systems,

cc) drive technology,

dd) automation,

ee) protective equipment and measures;

d) in the examination subject economics and social studies:

general economic and social conditions affecting occupation and work;

2. in the examination subject instrument technology

a) in the examination subject technology:

describe and present constructional forms properties, characteristics and typical areas of application for construction elements and the structure, mode of operation, functions and typical applications of modules, units and plant sections in the following areas:

aa) control technology,

bb) power technology,

cc) regulators,

dd) measurement technique,

ee) transmission;

b) in the examination subject circuit and function analysis:

aa) analyze the functions of power or communications modules based on prescribed circuit documents, data sheets and programmes ascertain and present electric and non-electric quantities, sequences and interconnections and assess the effects of prescribed actions and give reasons for these,

bb) select and sketch suitable circuits based on documents for prescribed typical measurement and test procedures on power or communications modules or units, give reasons for the selection of the units and ascertain and assess possible measuring errors dependent on units and circuits,

cc) ascertain components, lines and other materials needed to assemble and wire a module or a unit, specify requisite tools and working equipment and sketch component and circuit layouts based on technical documents;

c) in the examination subject technical mathematics:

aa) equiphase and single-phase alternating current circuits,

bb) polyphase circuits,

cc) control technology,

dd) measuring technique,

ee) transmission;

d) in the examination subject economics and social studies:

general economic and social conditions affecting occupation and work;

(4) The maximum times for the written examination shall be as follows:

1	in the examination subject technology	120 minutes,
2	in the examination subject circuit and function analysis	120 minutes,
3	in the examination subject technical mathematics	60 minutes,
4	in the examination subject economics and social studies	60 minutes

(5) The examination duration stipulated in subsection (4) may exceptionally be shortened, provided the written examination is conducted in programmed form.

(6) On request of the candidate or if deemed appropriate by the examining board, the written examination in individual subjects may be supplemented by an oral examination, where this may be decisive for a pass or fail. The written examination shall be allotted twice as many marks as compared to the oral examination.

(7) In the written examination, the examination subject technology shall be allotted twice as many marks as compared to each of the other examination subjects.

(8) A candidate shall be deemed to have passed the examination when he or she has obtained at least the grade adequate' in both the practical and written examinations as well as in the examination subject technology in the written examination.

Section 15

Final Examination for the Trainee Occupation of Communications Fitter

(1) The final examination shall encompass the skills and knowledge listed in Annexe 4 subject to subsection (4) of section 3 and the subject matter imparted in part-time vocational schools, provided this is pertinent to initial training

(2) The examination candidate shall be required to perform the following operations in a total of 14 hours :

1 in the specialized subject area information technology:

fabricate a test piece in a maximum of 7 hours and conduct four work tests in a maximum of 7 hours, with particular attention to be paid to the following:

a) as a test piece

fabricate, set, adjust and test an information processing module or unit according to documents including designing, inserting components into and wiring a printed circuit board module;

b) as work tests:

aa) construct a measuring setup, measure and ascertain analogue and digital signals and characteristics and draw up a calibration record,

bb) connect and commission an information processing unit or plant section including testing safety and protective equipment and conducting a test run and drawing up a record,

cc) identify, localize, rectify and document faults or malfunctions in an information processing unit or plant section,

dd) alter a programme according to documents and test the programme sequence.

The test piece and the work tests together shall each be accorded 50 per cent of the marks.

2. in the specialized subject area telecommunications technology :

fabricate a test piece in a maximum of 6 hours and conduct four work tests in a maximum of 8 hours, with particular attention to be paid to the following:

a) as a test piece

assemble and electrically wire modules to a telecommunications unit or a plant according to documents and test the unit or the plant;

b) as work tests:

aa) measure and test analogue and digital signals in a telecommunications module or unit and draw up a record,

bb) commission a telecommunications unit or a plant including testing functions, conducting a test run and drawing up a record,

cc) identify, localize, document and rectify faults in a telecommunications module, a unit or a plant,

dd) alter operating characteristics and performance characteristics of a functionally demarcated plant section catering for the operational state by encoding and switching on off or over.

The test pieces together shall be accorded 40 per cent of the marks as compared to 60 per cent for the work tests.

3. in the specialized subject area radio technology :

fabricate a test piece in a maximum of 7 hours and conduct four work tests in a maximum of 7 hours, with particular attention to be paid to the following:

a) as a test piece

fabricate, set, adjust and test a radio module or a unit according to documents including designing, inserting components into and wiring a printed circuit board module in laboratory wiring;

b) as work tests:

aa) construct a measurement setup, measure, check and ascertain low and high frequency analogue signals and characteristics and draw up a calibration record,

bb) construct a measurement setup, measure, check and ascertain digital signals and characteristics and draw up a calibration record,

BEST COPY AVAILABLE

cc) identify, localize, rectify and document faults or malfunctions in a radio module or unit,

dd) commission a radio unit including setting, adjusting and testing of functions, safety and protective equipment.

The test piece shall be accorded 50 per cent of the marks with 50 per cent for the work tests.

(3) The examination candidate shall be required to sit a written examination in the subjects technology, circuit and function analysis, technical mathematics and economics and social studies. In the examination subject circuit and function analysis, technical problems are to be analyzed and assessed, linking informational, technological and mathematical tasks and appropriate solutions presented. Tasks posed shall relate to practical situations, particularly from the following areas:-

1. in the specialized subject area information technology:

a) in the examination subject technology:

describe and present constructional forms, properties, characteristics and typical areas of application for construction elements and the structure, mode of operation, functions and typical applications of modules, units and plant sections in the following areas:

aa) amplifiers,

bb) power supply,

cc) data collection and transfer,

dd) data processing,

ee) process technology;

b) in the examination subject circuit and function analysis:

aa) analyze the functions of information or data processing modules based on prescribed circuit documents, data sheets and programmes, ascertain and present electric and non-electric quantities, sequences and interconnections and assess the effects of prescribed actions and give reasons for these,

bb) select and sketch suitable circuits based on documents for prescribed typical measurement and test procedures in information and data processing, give reasons for the selection of the units and ascertain and assess possible measuring errors dependent on units and circuits,

cc) ascertain components, lines and other materials needed to assemble and wire an information or data processing module or a unit, specify requisite tools and working equipment and sketch component and circuit layouts based on technical documents;

c) in the examination subject technical mathematics:

Ascertain and present electric quantities and characteristics from the following areas:

aa) equiphase and single-phase alternating current circuits,

bb) measuring technique,

cc) control technology,

dd) data transfer,

ee) data processing;

d) in the examination subject economics and social studies:

general economic and social conditions affecting occupation and work;

2. in the specialized subject area telecommunications technology:

a) in the examination subject technology:

describe and present constructional forms, properties, characteristics and typical areas of application for construction elements and the structure, mode of operation, functions and typical applications of modules, units and plant sections in the following areas:

aa) amplifiers,

bb) data processing,

cc) power supply,

dd) switching systems,

ee) transmission,

ff) terminals,

gg) signalling;

b) in the examination subject circuit and function analysis:

aa) analyze the functions of telecommunications modules, units or plant sections based on prescribed circuit documents, data sheets and programmes, ascertain and present electric and non-electric quantities, sequences and interconnections and assess the effects of prescribed actions and give reasons for these,

bb) select and sketch suitable circuits based on documents for prescribed typical measurement and test procedures in telecommunications, give reasons for the selection of the units and ascertain and assess possible measuring errors dependent on units and circuits,

cc) ascertain components, lines and other materials needed to mount and install a telecommunications plant section, specify requisite tools and working equipment and sketch component and circuit layouts based on technical documents;

c) in the examination subject technical mathematics

Ascertain and present electric quantities and characteristics from the following areas:

aa) equiphase and single-phase alternating current circuits,

bb) measuring technique,

cc) switching systems,

dd) transmission,

ee) signalling;

d) in the examination subject economics and social studies:

general economic and social conditions affecting occupation and work;

3 in the specialized subject area radio technology:

a) in the examination subject technology:

describe and present constructional forms, properties, characteristics and typical areas of application for construction elements and the structure, mode of operation, functions and typical applications of modules, units and plant sections in the following areas:

aa) amplifiers,

bb) data processing,

cc) power supply,

dd) transmitters and receivers,

ee) transmission,

ff) radar;

b) in the examination subject circuit and function analysis:

aa) analyze the functions of radio circuits, modules, or units based on prescribed circuit documents, data sheets and programmes, ascertain and present electric and non-electric quantities, sequences and interconnections and assess the effects of prescribed actions and give reasons for these,

bb) select and sketch suitable circuits based on documents for prescribed typical measurement and test procedures in radio technology, give reasons for the selection of the units and ascertain and assess possible measuring errors dependent on units and circuits,

cc) ascertain components, lines and other materials needed to mount and install a telecommunications plant section, specify requisite tools and working equipment and sketch component and circuit layouts based on technical documents;

c) in the examination subject technical mathematics:

Ascertain and present electric quantities and characteristics from the following areas:

aa) equiphase and single-phase alternating current circuits,

bb) measuring technique,

cc) regulators,

dd) transmitters and receivers,

ee) transmission;

d) in the examination subject economics and social studies:

general economic and social conditions affecting occupation and work;

(4) The maximum times for the written examination shall be as follows:

1.	in the examination subject technology	120 minutes,
2.	in the examination subject circuit and function analysis	120 minutes,
3.	in the examination subject technical mathematics	60 minutes,
4.	in the examination subject economics and social studies	60 minutes.

(5) The examination duration stipulated in subsection (4) may exceptionally be shortened, provided the written examination is conducted in programmed form.

(6) On request of the candidate or if deemed appropriate by the examining board, the written examination in individual subjects may be supplemented by an oral examination, where this may be decisive for a pass or fail. The written examination shall be allotted twice as many marks as compared to the oral examination.

(7) In the written examination, the examination subject technology shall be allotted twice as many marks as compared to each of the other examination subjects.

(8) A candidate shall be deemed to have passed the examination when he or she has obtained at least the grade 'adequate' in both the practical and written examinations as well as in the examination subject technology in the written examination.

Section 16

Annulment of Provisions

Subject to the Transitional Provision, section 19, the Regulations on Vocational Training in Electrical Technology of 12 December 1972 (BGBl. I p. 2385) amended by Regulations amending the Regulations concerning Vocational Training in Electrical Technology of 15 May 1973 (BGBl. I p. 464) are hereby annulled.

Part II

Vocational Training of Communications Fitter In the Federal Postal Administration

Section 17

Scope of Trainee Occupation

In as much as the training of communications fitters is imparted in the Federal Postal Administration, this occupation is a public occupation. The provisions in Part I of these Regulations shall apply to the training for this occupation.

Section 18

Annulment of Provisions

Subject to the Transitional Provision, section 19, the Regulations concerning the Vocational Training of Communications Mechanics of 9 October 1972 (BGBl. p. 1893) are hereby annulled.

Part III

Transitional and Final Provisions

Section 19

Transitional Provision

(1) For training relationships already in existence as of entry into force of these Regulations, the provisions hitherto in force shall obtain, unless the contract parties agree to apply the provisions of these Regulations for training relationships that have commenced after 31 July 1986 in the first training year.

(2) For training relationships begun before 31 December 1989, the contract parties may agree to apply the provisions hitherto in force.

Section 20

Application to West Berlin

These Regulations shall also apply according to section 14 of the Third Set of Transitional Provisions in conjunction with section 112 of the Vocational Training Act in Land Berlin.

Section 21

Entry into Force

These Regulations shall enter into force as of 1 August 1987.

Bonn, 15 January 1987

Federal Minister of Economics
Martin Bangemann

Federal Minister of
Posts and Telecommunications
Dr. Christian Schwarz-Schilling

GENERAL SYLLABUS
FOR THE VOCATIONAL TRAINING OF ELECTRICAL MACHINE FITTERS

Annexe 1
(to sec. 8)

I. Basic Training

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
1	Vocational training (Par. 1, sec. 4)	a) Explain the meaning of the training contract, particularly conclusion, duration and termination b) Specify the mutual rights and duties in the training contract c) Specify possibilities for further training	to be imparted during the entire training period			
2	Explain structure and tasks of training enterprise (Par. 2, sec. 4)	a) Explain structure and scope of activities of training enterprise b) Explain basic functions of training enterprise, such as procurement, manufacture, sales and administration c) Specify relations of training enterprise and its workforce to industrial organizations, trade associations and trade unions d) Describe the basis, mandates and mode of operation of training enterprise's labour relations bodies				
3	Labour legislation and legislation on wages and safety and health at work (Par. 3, sec. 4)	a) Specify main parts of contract of employment b) Specify major provisions of wage agreements affecting training enterprise c) Explain functions of safety and health provisions, trade associations responsible and trade inspectorate d) Specify main provisions of law on safety and health at work affecting training enterprise				
4	Industrial safety, environmental protection, data protection, rational use of energy (Par. 4, sec. 4)	a) Explain accident and health hazards especially of electric power, machines, hazardous working materials and workplaces and take measures to avoid them b) Observe major provisions and safety regulations when working with electric operating equipment and plant as stipulated in the trade accident prevention regulations (UVV VBG4) and DIN provisions for electrics/electronics (VDE) and other job-related provisions on health and safety at work c) Describe response in the case of accidents and fire and apply first aid measures d) Specify sources of environmental pollution at workplace and contribute to its reduction e) Specify and observe job-related regulations on data protection				

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		f) Specify forms of energy used in the training enterprise and possibilities for more rational utilization of energy in the immediate workplace and environment				
5	Fabrication of mechanical parts (Par. 5, sec. 4)	a) Read single part drawings in elevation and sectional views attending to types of line, scale, measurement entries with tolerance specifications and the symbols for surface finish and draw sketches b) Read assembly drawings, explosion views and parts lists c) Prepare and maintain tools, units, machines and auxiliary materials d) Determine work steps for the task to be performed and estimate the times required e) Select and handle measurement tools to measure and check lengths, angles and surfaces with the requisite measuring accuracy f) Measure lengths with rules and vernier calipers g) Measure angles with protractors and check them with angle gauges h) Check surfaces using the light slit method for evenness and shape accuracy i) Line out, grain and mark workpieces accounting for material properties k) Select tools and coolant lubricants accounting for the material to be machined, the machines and auxiliary materials l) Clamp workpieces and semi-fabricated components for machining accounting for surface protection m) Saw metal and plastic sheets, plates and profiles n) File and deburr metal and plastic workpieces to an accuracy of DIN 7168 and a surface finish of R_a 25 smooth and angular o) File and deburr roundings on metal and plastic workpieces true to shape p) Clamp drills/borers and counterboring/countersinking cutters with drill chucks and clamping cones q) Produce bores and countersinks in sheets, plates and profile parts with manually guided and stationary boring/drilling machines r) Produce counterbores with stationary boring/drilling machines		8		

BEST COPY AVAILABLE

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		s) Cut internal threads in metal and plastic workpieces t) Cut external threads in metal tubes/pipes and bars with thread-cutting dies u) Cut metal sheets and plastic plates with hand and hand-leaver shears and punch with punching tools v) Cold bend metal sheets and profile parts w) Straighten workpieces deformed by cutting or bending				
6	Produce mechanical connections (Par. 6, sec. 4)	a) Produce connections by means of screws, bolts and washers and fasten using fastening elements, in particular with spring rings, tooth-lock washers and varnish b) Select tools, solders and flux for soft welding accounting for properties and use c) Produce soft weld connections for mechanical and electric loads with electric soldering bits d) Select adhesives according to properties and use and bond similar and different materials according to instructions and documents		2		
7	Assembly and wiring of mechanical, electromechanical and electric components to modules (Par. 7, sec. 4)	a) Read technical drawings and circuit documents of modules, in particular terminal diagrams, unit wiring diagrams and circuit diagrams according to DIN 40719 and draw sketches b) Prepare and maintain tools, units, machines and auxiliary materials c) Determine work sequences to perform a given task, estimate the times required d) Prepare single-wire and multi-wire, screened and unscreened lines e) Attach terminal parts, in particular lugs, connector sleeves and plug sockets to lines f) Connect lines and attach to terminals, in particular by welding, clamping and plugging g) Prepare construction elements and components, in particular resistors, condensers, capacitors, coils and semiconductor elements for installation in modules, in particular by cutting off to length, bending, isolating and tinning according to instructions, documents and patterns h) Assemble construction elements and components, in particular profile parts, sheets, plates and fittings to mechanical modules, in particular to slide-in/plug-in units and housings		10		

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		i) Assemble construction elements and components in particular resistors, capacitors, coils, plug and socket connectors, fuses, switches, relays, contactors and signal lamps to electric modules k) Connect electromechanical and electric construction elements and components to form modules, in particular by means of overhead, trunk, channel and stripline wiring				
8	Preparation, laying and connection of lines to terminals (Par. 8, sec. 4)	a) Read technical plans and circuit documents, in particular circuit diagrams, block diagrams, installation schedules and terminal diagrams according to DIN 40719 for basic power and communications circuits and draw sketches b) Select, prepare and maintain tools, units, machines and auxiliary equipment c) Determine work sequences to perform given tasks and estimate the times required d) Select power and communications lines, in particular accounting for the type of layout and use according to tables e) Determine lines paths for prescribed end and junction points according to building and local conditions f) Lay and secure lines with clamps in pipes and channels according to documents and instructions g) Prepare lines for connection to terminals and attach terminal parts h) Connect lines according to instructions and documents and connect to operating equipment		10		
9	Measurement of zero-frequency and alternating quantities and checking of components and modules (Par. 9, sec. 4)	a) Select methods and measuring units, accounting in particular for internal resistance, estimate measuring errors and set up measuring equipment b) Measure voltage, current, resistance and power in direct-current circuits and calculate their ratios c) Register, present and evaluate measurement series and characteristics, in particular of resistances related to voltage, light and temperature d) Measure sinusoidal alternating voltage and sinusoidal alternating current in circuits with effective resistances e) Measure amplitude and cycle duration, in particular with an oscilloscope			10	

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		f) Check characteristics of components and construction elements, in particular of resistors and relays or contactors according to documents g) Check circuit layout, nominal values and function of modules according to documents and set nominal values h) Test circuits with basic logical functions, in particular AND, OR, NOT according to documents				
10		In further training the training contents of Nos. 5, 7 and 8 of this part of the General Syllabus should be imparted depending on the specific operating requirements and the trainee's progress	12			
II	**Specialized Training**					
1	Assembly and wiring of mechanical, electromechanical and electric modules and units (Par. 10, sec. 4)	a) Read technical drawings and circuit documents of modules and units, in particular layouts, circuit diagrams and equivalent circuit diagrams according to DIN 40719 and draw sketches b) Allocate and prepare components according to specific handling and installation specifications in particular with regard to avoiding static charge and thermal load, insert these in printed circuit boards and insert and remove by means of soldering c) Assemble modules and units according to instructions, documents and patterns d) Select lines, in particular with regard to colour codes, minimum cross sections and current carrying capacity according to provisions on DIN norms for electrics/electronics (VDE) e) Prepare lines and terminal parts, in particular mains plugs, couplings and multipolar plug and socket connectors and attach according to documents f) Wire modules and units with different wiring methods according to instructions, documents and patterns g) Compare layout and wiring of modules and units with technical documents, in particular by means of visual inspection and check continuity of electric connections h) Correct faults and document changes			9	

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
			4			
1	2	3				
2	Mounting and installation of functionally demarcated plant sections (Par. 11, sec. 4)	a) Read technical plans and circuit diagrams in power and communications technology, in particular communications charts and layouts, and draw sketches b) Mount operating equipment c) Determine line and cable paths under local conditions d) Select power and communications lines or cables accounting in particular for use, the mechanical and electric load and the method of wiring/cabling e) Lay, secure and connect lines or cables accounting in particular for mechanical load and local conditions f) Compare mounting and installation with technical documents, in particular by means of visual inspection and check continuity of electric connections g) Correct faults and document changes		9		
3	Checking, measuring and setting of modules and units (Par. 12, sec. 4)	a) Select methods to measure sinusoidal zero-frequency quantities in circuits with complex resistances and sketch measuring circuits, set up measuring equipment, measure voltage and current, determine phase shift b) Register by drawing voltage, current, impedance and reactance resistance accounting for phase shift c) Test function of digital circuits with basic logical functions, in particular circuits with pulse shapers and multivibrators according to instructions and documents d) Test function of digital circuits with integrated combinatory logic, in particular with coders, decoders, multiplexers and demultiplexers e) Measure pulse characteristics, in particular duration, frequency and pulse duty factor according to documents and present the pulse shape f) Select and set up testing and measuring units and test and measuring circuits to test the function of components, modules and units g) Test and set direct-current and alternating current modules and units in particular with resistors, coils, capacitors, transformers and discrete semiconductor elements according to test, adjustment and circuit documents h) Check and set electromechanical modules, in particular with relays, contactors and servo drivers according to test, adjustment and circuit documents and data sheets			6	

BEST COPY AVAILABLE

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		i) Check and set mechanical modules in particular with switches and drives according to test documents and instructions k) Represent test and measuring results in the form of tables and diagrams and evaluate according to instructions				
4	Commissioning of modules, units and functionally demarcated plant sections (Par. 13, sec. 4)	a) Check effectiveness of protective measures against direct contact according to instructions and regulations by means of visual inspection b) Conduct insulation checks according to regulations c) Check effectiveness of protective measures in the case of indirect contact, in particular protection by switching off with overcurrent protectors and fault current equipment in TN systems and by safety separation according to regulations d) Check equipment to protect against electrostatic charge e) Check protective equipment related to construction according to documents f) Commission modules, units and demarcated plant sections according to documents g) Conduct and document function tests under operating conditions according to documents		2		
5	Fabrication of mechanical components and modules for electric machines (Par. 14, sec. 4)	a) Read technical documents for the fabrication of mechanical components and modules and draw sketches b) Ream boreholes manually and with stationary boring machines accounting for material properties c) Sharpen hand tools manually on stationary grinding machines d) Machine metal and plastic workpieces accounting for cutting data and coolant lubricants to an accuracy of ±0.2 mm and a surface finish of between R_z = 10 µm and R_z = 63 µm by means of longitudinal spherical, transverse face, transverse plunge-cut, transverse cutting off and internal longitudinal turning e) Machine workpieces on a turning machine by means of drilling/boring and thread cutting with taps and thread-cutting dies f) Flame cut workpieces by hand g) Cut off metal workpieces with chisels h) Produce pin connections, in particular with parallel, taper and notched pins and clamp collars			8	

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		i) Produce positive connections for force transmission, in particular with wedges/keys, fitting keys and disk springs k) Produce hard solder connections for mechanical and electric loads on non-ferrous metals l) Produce welding connections on steel and copper without inspection tests, in particular by means of gas-fusion and arc welding m) Produce expansion and shrinkage connections by heating and cooling according to instructions and documents				
6	Fabrication of windings for electric machines (Par. 15, sec. 4)	a) Read technical documents for the fabrication of windings for electric machines and draw sketches b) Wind round and shaped conductor coils by hand and winding machine on coil shells and patterns according to documents c) Produce preformed coils and bar windings with fixtures by hand and mechanically according to diagrams d) Secure and insulate coils and winding layers by hand and mechanically according to documents		14		
7	Assembly and wiring of controls, regulators and monitoring equipment (Par. 16, sec. 4)	a) Assemble and wire voltage and power electronics components to modules according to documents b) Assemble and wire monitoring units, control and regulatory equipment according to documents		4		
8	Installation of windings in operative and non-operative machines and connection of windings (Par. 17, sec. 4)	a) Read technical documents on electric machines, in particular winding diagrams for motors, generators and transformers and draw sketches b) Prepare the insulation of activated iron, accounting in particular for mechanical, electrical, chemical and thermal load c) Prepare, insert and support winding elements d) Close core stacks in machines e) Connect together winding elements to windings f) Bandage rotor windings accounting for the mechanical load g) Install and connect thermal monitoring elements in windings h) Impregnate, harden and install windings accounting for special instructions for use and safety regulations				18

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3			4	
9	Mounting and dismantling of electric machines (Par. 18, sec. 4)	a) Read technical documents for the mounting and dismantling of operative and non-operative electric machines b) Install and remove slide bearings accounting for lubricating equipment c) Install and remove rolling bearings with fixtures accounting for fit d) Fabricate commutators by sawing, milling, scraping and deburring the slots e) Balance out moving parts with balancing equipment, in particular by attaching balancing weights and producing boreholes f) Mount and set current transfer parts in operative and non-operative electric machines g) Mount support and fastening elements for operative and non-operative electric machines accounting for mechanical and electric loads h) Mount components and modules, in particular stators, rotors, activated parts of transformers, ventilators and housings accounting for construction and mode of protection i) Mount and set auxiliary equipment, switchgear and monitoring equipment				14
10	Installation of electric machines and units in drive and power supply plant (Par. 19, sec. 4)	a) Read circuit documents, in particular circuit diagrams, communications charts, terminal diagrams, function diagrams, installation schedules and layouts for drive and energy supply plant b) Determine work sequences for the mounting of plant sections and the line installation according to local, economic and safety considerations in line with instructions c) Mount and install operating equipment in drive and power supply plant, in particular switchgear, controllers and regulators for electric machines and connect to terminals according to instructions and documents d) Erect, align, secure and connect electric machines to terminals				12
11	Setting up and monitoring of production installations for electric machines (Par. 20, sec. 4)	a) Set up production installations for electric machines, in particular coil winding machines, machines for the machining of slot and winding insulation and equipment for the deformation of coils accounting for construction and functional relations according to documents and instructions b) Monitor production installations for electric machines				4

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
12	Checking, measuring and setting of electric machines and related units (Par. 21, sec. 4)	a) Select methods to measure electric and non-electric quantities and to test function accounting for specific properties of measuring devices and set up measuring and test equipment b) Measure electric quantities, in particular current, voltage, power and work, also using series and shunt resistors and transducers, and frequency, power factor and firing angle on current valves in single-phase and polyphase power systems c) Measure, check and set electric quantities and characteristics, in particular on rotating field machines, direct current machines and transformers according to documents, data sheets and instructions d) Determine phase sequences in polyphase systems and compare phase positions, in particular when synchronizing generators and parallel switching in transformers e) Measure insulation resistance in windings and check breakdown strength of high voltage insulation according to documents f) Check and measure non-electric quantities on electric machines, in particular torque, speed and temperatures with direct and indirect measuring methods according to documents g) Set mechanical components and modules of electric machines, test individual and overall functions according to circuit and test documents h) Set hard-wired and stored-programme controllers and regulators for electric machines with the help of function descriptions, circuit documents and programming instructions and conduct function tests i) Record and evaluate test and measuring results				14
13	Commissioning of electric machines and related units (Par. 22, sec. 4)	a) Check for proper line installation, line connection and terminal connections accounting for mechanical and electric loads and where necessary record these b) Check effectiveness of measures for protection against shock currents c) Check effectiveness of mechanical and electric fusegear d) Check electric power supply with regard to polarity, voltage, frequency, phase sequence and position e) Distinguish electric machines according to mechanical and electric characteristics accounting for operating characteristics and conditions				

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		f) Set and test individual functions accounting for given characteristics and parameters under operational conditions according to instructions and documents g) Conduct test runs of electric machines and related controllers and regulators under nominal and boundary conditions according to documents h) Explain operating instructions and maintenance regulations to the operator			8	
14	Maintenance of electric machines and related units (Par. 23, sec. 4)	a) Conduct inspection according to documents and document results b) Conduct maintenance work according to operating instructions and maintenance regulations c) Identify, localize and rectify malfunctions by means of systematic troubleshooting d) Document winding data, in particular during servicing e) Service electric machines by replacing windings or winding parts f) Replace faulty mechanical and electromechanical components or modules and skim commutators g) Alter control functions in hard-wired and stored-progamme units according to instructions and documents			8	

Annexe 2
(to sec. 8)

GENERAL SYLLABUS
FOR THE VOCATIONAL TRAINING OF POWER ELECTRONICS MECHANICS

I. Basic Training

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
1	Vocational training (Par. 1, subsec. (1), sec. 5)	a) Explain the meaning of the training contract, particularly conclusion, duration and termination b) Specify the mutual rights and duties in the training contract c) Specify possibilities for further training				
2	Explain structure and tasks of training enterprise (Par. 2, subsec. (1), sec. 5)	a) Explain structure and scope of activities of training enterprise b) Explain basic functions of training enterprise, such as procurement, manufacture, sales and administration c) Specify relations of training enterprise and its workforce to industrial organizations, trade associations and trade unions d) Describe the basis, mandates and mode of operation of training enterprise's labour relations bodies	to be imparted during the entire training period			
3	Labour legislation and legislation on wages and safety and health at work (Par. 3, subsec. (1), sec. 5)	a) Specify main parts of contract of employment b) Specify major provisions of wage agreements affecting training enterprise c) Explain functions of safety and health provisions, trade associations responsible and trade inspectorate d) Specify main provisions of law on safety and health at work affecting training enterprise				
4	Industrial safety, environmental protection, data protection, rational use of energy (Par. 4, subsec. (1), sec. 5)	a) Explain accident and health hazards especially of electric power, machines, hazardous working materials and workplaces and take measures to avoid them b) Observe major provisions and safety regulations when working with electric operating equipment and plant as stipulated in the trade accident prevention regulations (UVV VBG4) and DIN provisions for electrics/elecronics (VDE) and other job-related provisions on health and safety at work c) Describe response in the case of accidents and fire and apply first aid measures d) Specify sources of environmental pollution at workplace and contribute to its reduction e) Specify and observe job-related regulations on data protection f) Specify forms of energy used in the training enterprise and possibilities for more rational utilization of energy in the immediate workplace and environment				

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
5	Fabrication of mechanical parts (Par 5, subsec (1), sec 5)	a) Read single part drawings in elevation and sectional views attending to types of line, scale, measurement entries with tolerance specifications and the symbols for surface finish and draw sketches b) Read assembly drawings, explosion views and parts lists c) Prepare and maintain tools, units, machines and auxiliary materials d) Determine work steps for the task to be performed and estimate the times required e) Select and handle measurement tools to measure and check lengths, angles and surfaces with the requisite measuring accuracy f) Measure lengths with rules and vernier calipers g) Measure angles with protractors and check them with angle gauges h) Check surfaces using the light slit method for evenness and shape accuracy i) Line out, grain and mark workpieces accounting for material properties k) Select tools and coolant lubricants accounting for the material to be machined, the machines and auxiliary materials l) Clamp workpieces and semi-fabricated components for machining accounting for surface protection m) Saw metal and plastic sheets, plates and profiles n) File and deburr metal and plastic workpieces to an accuracy of DIN 7168 and a surface finish of R_z 25 smooth and angular o) File and deburr roundings on metal and plastic workpieces true to shape p) Clamp drills/borers and counterboring/countersinking cutters with drill chucks and clamping cones q) Produce bores and countersinks in sheets, plates and profile parts with manually guided and stationary boring/drilling machines r) Produce counterbores with stationary boring/drilling machines s) Cut internal threads in metal and plastic workpieces t) Cut external threads in metal tubes/pipes and bars with thread-cutting dies u) Cut metal sheets and plastic plates with hand and hand-leaver shears and punch with punching tools		8		

BEST COPY AVAILABLE

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		v) Cold bend metal sheets and profile parts w) Straighten workpieces deformed by cutting or bending				
6	Produce mechanical connections (Par. 6, subsec.(1), sec. 5)	a) Produce connections by means of screws, bolts and washers and fasten using fastening elements, in particular with spring rings, tooth-lock washers and varnish b) Select tools, solders and flux for soft welding accounting for properties and use c) Produce soft weld connections for mechanical and electric loads with electric soldering bits d) Select adhesives according to properties and use and bond similar and different materials according to instructions and documents	2			
7	Assembly and wiring of mechanical, electromechanical and electric components to modules (Par. 7, subsec.(1), sec. 5)	a) Read technical drawings and circuit documents of modules, in particular terminal diagrams, unit wiring diagrams and circuit diagrams according to DIN 40719 and draw sketches b) Prepare and maintain tools, units, machines and auxiliary materials c) Determine work sequences to perform a given task, estimate the times required d) Prepare single-wire and multi-wire, screened and unscreened lines e) Attach terminal parts, in particular lugs, connector sleeves and plug sockets to lines f) Connect lines and attach to terminals, in particular by welding, clamping and plugging g) Prepare construction elements and components, in particular resistors, condensers, capacitors, coils and semiconductor elements for installation in modules, in particular by cutting off to length, bending, isolating and tinning according to instructions, documents and patterns h) Assemble construction elements and components, in particular profile parts, sheets, plates and fittings to mechanical modules, in particular to slide-in/plug-in units and housings i) Assemble construction elements and components in particular resistors, capacitors, coils, plug and socket connectors, fuses, switches, relays, contactors and signal lamps to electric modules k) Connect electromechanical and electric construction elements and components to form modules, in particular by means of overhead, trunk, channel and stripline wiring	10			

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
8	Preparation, laying and connection of lines to terminals (Par. 8, subsec. (1), sec. 5)	a) Read technical plans and circuit documents, in particular circuit diagrams, block diagrams, installation schedules and terminal diagrams according to DIN 40719 for basic power and communications circuits and draw sketches b) Select, prepare and maintain tools, units, machines and auxiliary equipment c) Determine work sequences to perform given tasks and estimate the times required d) Select power and communications lines, in particular accounting for the type of layout and use according to tables e) Determine lines paths for prescribed end and junction points according to building and local conditions f) Lay and secure lines with clamps in pipes and channels according to documents and instructions g) Prepare lines for connection to terminals and attach terminal parts h) Connect lines according to instructions and documents and connect to operating equipment	10			
9	Measurement of zero-frequency and alternating quantities and checking of components and modules (Par. 9, subsec. (1), sec. 5)	a) Select methods and measuring units, accounting in particular for internal resistance, estimate measuring errors and set up measuring equipment b) Measure voltage, current, resistance and power in direct-current circuits and calculate their ratios c) Register, present and evaluate measurement series and characteristics, in particular of resistances related to voltage, light and temperature d) Measure sinusoidal alternating voltage and sinusoidal alternating current in circuits with effective resistances e) Measure amplitude and cycle duration, in particular with an oscilloscope f) Check characteristics of components and construction elements, in particular of resistors and relays or contactors according to documents g) Check circuit layout, nominal values and function of modules according to documents and set nominal values h) Test circuits with basic logical functions, in particular AND, OR, NOT according to documents		10		

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
10		In further training the training contents of Nos. 5, 7 and 8 of this part of the General Syllabus should be imparted depending on the specific operating requirements and the trainee's progress	12			

II. Specialized Training

1	Assembly and wiring of mechanical, electromechanical and electric modules and units (Par. 10, subsec. (1), sec. 5)	a) Read technical drawings and circuit documents of modules and units, in particular layouts, circuit diagrams and equivalent circuit diagrams according to DIN 40719 and draw sketches b) Allocate and prepare components according to specific handling and installation specifications in particular with regard to avoiding static charge and thermal load, insert these in printed circuit boards and insert and remove by means of soldering c) Assemble modules and units according to instructions, documents and patterns d) Select lines, in particular with regard to colour codes, minimum cross sections and current carrying capacity according to provisions on DIN norms for electrics/electronics (VDE) e) Prepare lines and terminal parts, in particular mains plugs, couplings and multipolar plug and socket connectors and attach according to documents f) Wire modules and units with different wiring methods according to instructions, documents and patterns g) Compare layout and wiring of modules and units with technical documents, in particular by means of visual inspection and check continuity of electric connections h) Correct faults and document changes		9		
2	Mounting and installation of functionally demarcated plant sections (Par. 11, subsec. (1), sec. 5)	a) Read technical plans and circuit diagrams in power and communications technology, in particular communications charts and layouts, and draw sketches b) Mount operating equipment c) Determine line and cable paths under local conditions d) Select power and communications lines or cables accounting in particular for use, the mechanical and electric load and the method of wiring/cabling e) Lay, secure and connect lines or cables accounting in particular for mechanical load and local conditions			9	

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		f) Compare mounting and installation with technical documents, in particular by means of visual inspection and check continuity of electric connections g) Correct faults and document changes				
3	Checking, measuring and setting of modules and units (Par. 12, subsec. (1), sec. 5)	a) Select methods to measure sinusoidal zero-frequency quantities in circuits with complex resistances and sketch measuring circuits, set up measuring equipment, measure voltage and current, determine phase shift b) Register by drawing voltage, current, impedance and reactance resistance accounting for phase shift c) Test function of digital circuits with basic logical functions, in particular circuits with pulse shapers and multivibrators according to instructions and documents d) Test function of digital circuits with integrated combinatory logic, in particular with coders, decoders, multiplexers and demultiplexers e) Measure pulse characteristics, in particular duration, frequency and pulse duty factor according to documents and present the pulse shape f) Select and set up testing and measuring units and test and measuring circuits to test the function of components, modules and units g) Test and set direct-current and alternating current modules and units in particular with resistors, coils, capacitors, transformers and discrete semiconductor elements according to test, adjustment and circuit documents h) Check and set electromechanical modules, in particular with relays, contactors and servo drivers according to test, adjustment and circuit documents and data sheets i) Check and set mechanical modules in particular with switches and drives according to test documents and instructions k) Represent test and measuring results in the form of tables and diagrams and evaluate according to instructions			6	
		l) Select methods to measure effective and reactive power, set up measuring equipment and conduct measurements m) Derive apparent power and phase shift from effective and reactive power n) Determine power factor from effective, reactive and apparent power o) Measure power factor, electric work and frequency			7	

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		p) Measure current, voltage, power and electric work via current and voltage transformers q) Test function of multivibrators with static and dynamic inputs according to documents r) Test functions of basic circuits in sequential logic, in particular of meters/counters, registers and memories according to documents				
4	Commissioning of modules, units and functionally demarcated plant sections (Par. 13, subsec. (1), sec. 5)	a) Check effectiveness of protective measures against direct contact according to instructions and regulations by means of visual inspection b) Conduct insulation checks according to regulations c) Check effectiveness of protective measures in the case of indirect contact, in particular protection by switching off with overcurrent protectors and fault current equipment in TN systems by safety separation according to regulations d) Check equipment to protect against electrostatic charge e) Check protective equipment related to construction according to documents f) Commission modules, units and demarcated plant sections according to documents g) Conduct and document function tests under operating conditions according to documents		2		
		h) Check voltage, frequency and phase sequence of electric power supply i) Commission plant sections, determine operating characteristics by means of observation and measurement and document these		3		
5	Assembly, wiring, mounting and installation of power modules and plant sections (Par. 14, subsec. (1), sec. 5)	a) Read circuit documents for switchgear, control and power supply plant, in particular circuit diagrams, installation schedules and terminal diagrams and draw sketches b) Arrange components for switchgear and power distribution plant and assemble and wire these to modules, in particular accounting for switching capacity c) Arrange control and signal components with contactors, relays and digital functional units and assemble and wire these to modules d) Select, lay, secure and connect lines or cables to terminals according to instructions and documents e) Set up, align, secure and connect plant sections to terminals according to instructions and documents			16	

BL Advanced Training in Subject Areas

A Plant Technology

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3			4	
1	Assembly and wiring of circuit, control and power distribution modules and units (Par. 1a, subsec. (2), sec. 5)	a) Assemble mechanical constructional parts for switchgear combinations and distribution boards b) Assemble, extend and connect switchgear combinations and distribution boards with operating equipment for switching, control, regulating, measuring and monitoring			12	
2	Preparation and completion of mounting work (Par. 1b, subsec. (2), sec. 5)	a) Read technical documents, in particular installation schedules and determine installation layout according to local conditions b) Allocate and prepare material, operating equipment and tools according to safety and economic aspects c) Plan, coordinate and set work sequences according to safety, work organization and economic aspects d) Draw up stock allowance and time documents according to instructions			4	
3	Mounting of lines, cables and installation systems (Par. 1c, subsec. (2), sec. 5)	a) Coordinate, determine and prepare line and cable paths accounting for mechanical load and the type of installation according to local conditions b) Assemble and mount installation systems c) Lay, secure and connect lines and cables according to installation layout, in particular in channels and pipes, in cable troughs, on and under plasterwork accounting for wiring/cabling specifications d) Lay and secure earths and potential equalization lines			18	
4	Mounting and installation of power distribution, control, signalling and lighting plant and of electric machines and servo equipment (Par. 1d, subsec. (2), sec. 5)	a) Mount and connect operating equipment for main, auxiliary and control circuits b) Set up, align, assemble and connect plant sections to terminals, in particular switchgear combinations and distribution boards c) Assemble, mount and install power distribution and signalling plant sections as well as servo equipment, switchgear and controllers according to documents d) Set up, secure and connect electric machines to terminals e) Install and connect stored-programme controllers to terminals f) Install lighting plant			20	

BEST COPY AVAILABLE

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3			4	
5	Measurement of non-electric quantities and testing of function of stored-programme controllers (Par. 1e, subsec. (2), sec. 5)	a) Measure rotational frequency, in particular with transducers b) Measure temperatures, in particular with measuring resistors c) Check control commands, control programmes and input and output signals in stored-programme controllers according to documents d) Check signals for memory, time, marker and counter functions with test routines				8
6	Measurement of non-electric quantities and testing of function of stored-programme controllers (Par. 1f, subsec. (2), sec. 5)	a) Inspect plant for standard design, in particular the class and type of protection b) Check and document effectiveness of protective measures by measuring the insulation resistances, earthing resistances and loop impedances c) Check and document effectiveness of overcurrent and fault current protective equipment as well as insulation monitoring equipment by means of function tests and by measuring d) Check effectiveness of mechanical and electric safety equipment, in particular emergency stop switches e) Check and commission auxiliary and main circuits including related signal and control stations for measuring, control and monitoring equipment f) Check main circuits and commission step by step, measure operating characteristics and set control values g) Input, change and supplement control programmes for stored-programme controllers h) Check sensors and actuators of stored-programme controllers i) Check programme and operational sequences and commission control k) Check transformers for fault to frame and winding to frame short circuits l) Check operative electric machines, in particular squirrel-cage rotors for winding to frame and fault to frame short circuits m) Update circuit documents				10
7	Maintenance of power plant (Par. 1g, subsec. (2), sec. 5)	a) Maintain plant sections to ensure operation according to service documents and instructions b) Determine malfunctions and faults in plant sections by means of systematic fault localization and rectify these by replacing faulty functional units c) Document work conducted				6

8 Operations Technology

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
1	Assembly and wiring of operating equipment and switchgear for power plant (Par. 2a, subsec. (2), sec. 5)	a) Assemble support structures, covers/enclosures and subdivision for the construction of switchgear combinations b) Assemble, wire and mark control and monitoring operating equipment on installation frames and on slide-in/plug in units c) Install, wire and mark power electronics switchgear, in particular on-load and power switches, fuses and operating equipment				12
2	Mounting and installation of power operating equipment and plant (Par. 2b, subsec. (2), sec. 5)	a) Plan, coordinate and determine work sequences according to safety, work organization and economic aspects b) Mount, install and connect electric machines, servo equipment, switchgear and controllers as well as busbar trunking systems to terminals according to documents and accounting for the type of protection and explosion precautions c) Install and adapt interfaces for measuring, control, signalling and monitoring operational sequences or processes d) Install and connect programmable controllers to terminals e) Alter and extend plant accounting for function, safety regulations and selectivity and document changes				14
3	Measurement of non-electric quantities and testing of functions of measuring equipment, controls and regulators (Par. 2c, subsec. (2), sec. 5)	a) Measure rotational frequency with transducers b) Measure temperatures, in particular with measuring resistors c) Check, set and adjust function of modules, in particular accounting for control, actuating, reference and disturbance quantities d) Check and set the function of modules in particular circuits with operation amplifiers and optical couplers e) Test input and output signals in stored-programme controllers with the help of test routines f) Check programme sequences g) Check interfaces and peripheral units				18
4	Commissioning of power operating equipment and plant (Par. 2d, subsec. (2), soc. 5)	a) Check effectiveness of safety measures and protective equipment according to VDE 0100 by means of inspection, testing and measuring b) Check effectiveness of mechanical and electric safety equipment, in particular emergency stop switches				

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		c) Set overcurrent trips and short-circuit trips d) Check interfaces to pneumatic and hydraulic systems e) Commission plant step by step according to instructions, test functions according to documents, measure operating characteristics, set control values f) Design and input control programmes, in particular for sequence and logic controls with memory, time, marker and counter functions according to documents g) Carry out changes and extensions of control programmes according to documents and instructions h) Check transformers for winding to frame and fault to frame short-circuits and measure voltage under load i) Check operative electric machines, in particular machines with squirrel-cage rotors for winding to frame and fault to frame short-circuits k) Update technical documents, in particular circuit documents and control programmes				8
5	Maintenance of power distribution, lighting, control and drive operating equipment and plant (Par. 2e, subsec. (2), sec. 5)	a) Inspect units and plant b) Maintain units and plant according to maintenance schedules				6
		c) Identify malfunctions and faults in modules, units and plant by means of systematic fault localization d) Service modules, units and plant accounting for function, operational characteristics and the type and class of protection e) Conduct troubleshooting in plant with modules and units controlled by microprocessors using test units and test programmes and restore functionality by replacing faulty modules f) Document work conducted				20

Annex 3
(to sec. 8)

GENERAL SYLLABUS FOR THE VOCATIONAL TRAINING OF INDUSTRIAL ELECTRONICS MECHANICS

I. Basic Training

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
1	Vocational training (Par. 1, subsec. (1), sec. 6)	a) Explain the meaning of the training contract, particularly conclusion, duration and termination b) Specify the mutual rights and duties in the training contract c) Specify possibilities for further training	to be imparted during the entire training period			
2	Explain structure and tasks of training enterprise (Par. 2, subsec. (1), sec. 6)	a) Explain structure and scope of activities of training enterprise b) Explain basic functions of training enterprise, such as procurement, manufacture, sales and administration c) Specify relations of training enterprise and its workforce to industrial organizations, trade associations and trade unions d) Describe the basis, mandates and mode of operation of training enterprise's labour relations bodies				
3	Labour legislation and legislation on wages and safety and health at work (Par. 3, subsec. (1), sec. 6)	a) Specify main parts of contract of employment b) Specify major provisions of wage agreements affecting training enterprise c) Explain functions of safety and health provisions, trade associations responsible and trade inspectorate d) Specify main provisions of law on safety and health at work affecting training enterprise				
4	Industrial safety, environmental protection, data protection, rational use of energy (Par. 4, subsec. (1), sec. 6)	a) Explain accident and health hazards especially of electric power, machines, hazardous working materials and workplaces and take measures to avoid them b) Observe major provisions and safety regulations when working with electric operating equipment and plant as stipulated in the trade accident prevention regulations (UVV VBG4) and DIN provisions for electrics/electronics (VDE) and other job-related provisions on health and safety at work c) Describe response in the case of accidents and fire and apply first aid measures d) Specify sources of environmental pollution at workplace and contribute to its reduction e) Specify and observe job-related regulations on data protection f) Specify forms of energy used in the training enterprise and possibilities for more rational utilization of energy in the immediate workplace and environment				

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
5	Fabrication of mechanical parts (Par. 5, subsec. (1), sec. 6)	a) Read single part drawings in elevation and sectional views attending to types of line, scale, measurement entries with tolerance specifications and the symbols for surface finish and draw sketches				
		b) Read assembly drawings, explosion views and parts lists				
		c) Prepare and maintain tools, units, machines and auxiliary materials				
		d) Determine work steps for the task to be performed and estimate the times required				
		e) Select and handle measurement tools to measure and check lengths, angles and surfaces with the requisite measuring accuracy				
		f) Measure lengths with rules and vernier calipers				
		g) Measure angles with protractors and check them with angle gauges				
		h) Check surfaces using the light slit method for evenness and shape accuracy				
		i) Line out, grain and mark workpieces accounting for material properties				
		k) Select tools and coolant lubricants accounting for the material to be machined, the machines and auxiliary materials				
		l) Clamp workpieces and semi-fabricated components for machining accounting for surface protection	8			
		m) Saw metal and plastic sheets, plates and profiles				
		n) File and deburr metal and plastic workpieces to an accuracy of DIN 7168 and a surface finish of R_t 25 smooth and angular				
		o) File and deburr roundings on metal and plastic workpieces true to shape				
		p) Clamp drills/borers and counterboring/countersinking cutters with drill chucks and clamping cones				
		q) Produce bores and countersinks in sheets, plates and profile parts with manually guided and stationary boring/drilling machines				
		r) Produce counterbores with stationary boring/drilling machines				
		s) Cut internal threads in metal and plastic workpieces				
		t) Cut external threads in metal tubes/pipes and bars with thread-cutting dies				
		u) Cut metal sheets and plastic plates with hand and hand-leaver shears and punch with punching tools				

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		v) Cold bend metal sheets and profile parts w) Straighten workpieces deformed by cutting or bending				
6	Produce mechanical connections (Par. 6, subsec. (1), sec. 6)	a) Produce connections by means of screws, bolts and washers and fasten using fastening elements, in particular with spring rings, tooth-lock washers and varnish b) Select tools, solders and flux for soft welding accounting for properties and use c) Produce soft weld connections for mechanical and electric loads with electric soldering bits d) Select adhesives according to properties and use and bond similar and different materials according to instructions and documents	2			
7	Assembly and wiring of mechanical, electromechanical and electric components to modules (Par. 7, subsec. (1), sec. 6)	a) Read technical drawings and circuit documents of modules, in particular terminal diagrams, unit wiring diagrams and circuit diagrams according to DIN 40719 and draw sketches b) Prepare and maintain tools, units, machines and auxiliary materials c) Determine work sequences to perform a given task, estimate the times required d) Prepare single-wire and multi-wire, screened and unscreened lines e) Attach terminal parts, in particular lugs, connector sleeves and plug sockets to lines f) Connect lines and attach to terminals, in particular by welding, clamping and plugging g) Prepare construction elements and components, in particular resistors, condensers, capacitors, coils and semiconductor elements for installation in modules, in particular by cutting off to length, bending, isolating and tinning according to instructions, documents and patterns h) Assemble construction elements and components, in particular profile parts, sheets, plates and fittings to mechanical modules, in particular to slide-in/plug-in units and housings i) Assemble construction elements and components in particular resistors, capacitors, coils, plug and socket connectors, fuses, switches, relays, contactors and signal lamps to electric modules k) Connect electromechanical and electric construction elements and components to form modules, in particular by means of overhead, trunk, channel and stripline wiring		10		

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
8	Preparation, laying and connection of lines to terminals (Par. 8, subsec. (1), sec. 6)	a) Read technical plans and circuit documents, in particular circuit diagrams, block diagrams, installation schedules and terminal diagrams according to DIN 40719 for basic power and communications circuits and draw sketches b) Select, prepare and maintain tools, units, machines and auxiliary equipment c) Determine work sequences to perform given tasks and estimate the times required d) Select power and communications lines, in particular accounting for the type of layout and use according to tables e) Determine lines paths for prescribed end and junction points according to building and local conditions f) Lay and secure lines with clamps in pipes and channels according to documents and instructions g) Prepare lines for connection to terminals and attach terminal parts h) Connect lines according to instructions and documents and connect to operating equipment	10			
9	Measurement of zero-frequency and alternating quantities and checking of components and modules (Par. 9, subsec. (1), sec. 6)	a) Select methods and measuring units, accounting in particular for internal resistance, estimate measuring errors and set up measuring equipment b) Measure voltage, current, resistance and power in direct-current circuits and calculate their ratios c) Register, present and evaluate measurement series and characteristics, in particular of resistances related to voltage, light and temperature d) Measure sinusoidal alternating voltage and sinusoidal alternating current in circuits with effective resistances e) Measure amplitude and cycle duration, in particular with an oscilloscope f) Check characteristics of components and construction elementss, in particular of resistors and relays or contactors according to documents g) Check circuit layout, nominal values and function of modules according to documents and set nominal values h) Test circuits with basic logical functions, in particular AND, OR, NOT according to documents		10		

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
10		In further training the training contents of Nos. 5, 7 and 8 of this part of the General Syllabus should be imparted depending on the specific operating requirements and the trainee's progress	12			

II. Specialized Training

1	Assembly and wiring of mechanical, electromechanical and electric modules and units (Par. 10, subsec. (1), sec. 6)	a) Read technical drawings and circuit documents of modules and units, in particular layouts, circuit diagrams and equivalent circuit diagrams according to DIN 40719 and draw sketches b) Allocate and prepare components according to specific handling and installation specifications in particular with regard to avoiding static charge and thermal load, insert these in printed circuit boards and insert and remove by means of soldering c) Assemble modules and units according to instructions, documents and patterns d) Select lines, in particular with regard to colour codes, minimum cross sections and current carrying capacity according to provisions on DIN norms for electrics/electronics (VDE) e) Prepare lines and terminal parts, in particular mains plugs, couplings and multipolar plug and socket connectors and attach according to documents f) Wire modules and units with different wiring methods according to instructions, documents and patterns g) Compare layout and wiring of modules and units with technical documents, in particular by means of visual inspection and check continuity of electric connections h) Correct faults and document changes			9	
		i) Read technical documents for mechanical, electromechanical and electric modules and units, in particular with digital, control and pneumatic symbols and draw sketches k) Ream boreholes/drillholes in workpieces by hand and mechanically accounting for cutting data and coolants and lubricants l) Fit drive parts by means of spring connections, pin connections, clamp collars, set collars and retaining rings m) Mount modules or units with moving parts, in particular axles, shafts, drives according to assembly drawings n) Assemble and connect pneumatic constructional elements and modules o) Select and prepare lines accounting for characteristics of units according to documents			14	

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		p) Assemble and wire modules and units with electric and electromechanical operating equipment according to documents q) Control modules and units as part of work conducted and rectify faults				
2	Mounting and installation of functionally demarcated plant sections (Par. 11, subsec. (1), sec. 6)	a) Read technical plans and circuit diagrams in power and communications technology, in particular communications charts and layouts, and draw sketches b) Mount operating equipment c) Determine line and cable paths under local conditions d) Select power and communications lines or cables accounting in particular for use, the mechanical and electric load and the method of wiring/cabling e) Lay, secure and connect lines or cables accounting in particular for mechanical load and local conditions f) Compare mounting and installation with technical documents, in particular by means of visual inspection and check continuity of electric connections g) Correct faults and document changes		9		
3	Checking, measuring and setting of modules and units (Par. 12, subsec. (1), sec. 6)	a) Select methods to measure sinusoidal zero-frequency quantities in circuits with complex resistances and sketch measuring circuits, set up measuring equipment, measure voltage and current, determine phase shift b) Register by drawing voltage, current, impedance and reactance resistance accounting for phase shift c) Test function of digital circuits with basic logical functions, in particular circuits with pulse shapers and multivibrators according to instructions and documents d) Test function of digital circuits with integrated combinatory logic, in particular with coders, decoders, multiplexers and demultiplexers e) Measure pulse characteristics, in particular duration, frequency and pulse duty factor according to documents and present the pulse shape f) Select and set up testing and measuring units and test and measuring circuits to test the function of components, modules and units			6	

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		g) Test and set direct-current and alternating current modules and units in particular with resistors, coils, capacitors, transformers and discrete semiconductor elements according to test, adjustment and circuit documents h) Check and set electromechanical modules, in particular with relays, contactors and servo drivers according to test, adjustment and circuit documents and data sheets i) Check and set mechanical modules in particular with switches and drives according to test documents and instructions k) Represent test and measuring results in the form of tables and diagrams and evaluate according to instructions				
		l) Select methods to measure effective power also using transducers in single-phase and polyphase systems, set up measuring equipment and conduct measurements, ascertain apparent power, reactive power and power factor m) Check function of multivibrators with static and dynamic inputs according to documents n) Check functions of basic circuits in sequential logic, in particular of counters/meters, registers and memories according to documents o) Document test and measurement results		6		
4	Commissioning of modules, units and functionally demarcated plant sections (Par. 13, subsec. (1), sec. 6)	a) Check effectiveness of protective measures against direct contact according to instructions and regulations by means of visual inspection b) Conduct insulation checks according to regulations c) Check effectiveness of protective measures in the case of indirect contact, in particular protection by switching off with overcurrent protectors and fault current equipment in TN systems and by safety separation according to regulations d) Check equipment to protect against electrostatic charge e) Check protective equipment related to construction according to documents f) Commission modules, units and demarcated plant sections according to documents g) Conduct and document function tests under operating conditions according to documents		2		
		h) Commission modules and units, in particular power supply units, functionally demarcated controls and pneumatic modules by means of checking, setting and adjusting according to documents				

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		i) Commission digital modules and units, in particular with counters/meters, registers and memories according to instructions k) Check effectiveness of protective measures in the case of indirect contact, in particular protection via protection low voltage, protective insulation and cut-out protection by means of inspection, tests and measurement		6		

III. Advanced Training in Subject Areas
A. Production Technology

1	Commissioning of modules, units and functionally demarcated plant sections (Par. 13, subsec. (2), sec. 6)	a) Read technical documents for the mounting of hydraulic equipment and draw sketches b) Assemble and connect digital, control, drive, pneumatic and hydraulic modules and units accounting for earthing, interference suppression, leakproofing and regulations on protection according to documents and instructions c) Install, set and connect sensors to register pressure, temperature, speed and motion sequences according to documents d) Check effectiveness of protective measures on production installations, in particular by function, insulation and high voltage tests			20
2	Setting up and supervision of automated production installations (Par. 1b, subsec. (2), sec. 6)	a) Identify and interpret the structure and functional relations of automated production installations b) Connect to terminals and operate peripheral units, in particular data input, output, transfer and display units accounting for interface conditions based on documents c) Alter functional characteristics by mechanical and electric interventions, in particular in sensors and actuators based on documents d) Alter functional characteristics by inputting parameters for process sequence and interventions in the control programmes according to documents and instructions e) Connect signal units to terminals and set them, in particular warning, monitoring and diagnostic equipment based on documents f) Control, monitor and document function and process sequences, in particular accounting for quality control, based on technical documents			20

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
3	Checking, measurement, setting and adjustment of function and process sequences in automated production installations (Par. 1c, subsec. (2), sec. 6)	a) Set, adjust and check operating characteristics of production installations according to instructions, circuit and test documents and data sheets b) Check and set function of measuring, control and monitoring equipment, in particular accounting for controlled, actuating, reference and disturbance quantities c) Set, adjust and check components and modules in production installations, in particular position switches, control drives, switching amplifiers and switching power supplies accounting for functional characteristics d) Measure non-electric quantities, in particular speed, pressure and temperature directly and using transducers according to documents and instructions e) Set, adjust and check units and production installations, in particular magazines, buffers, feed and removal units and handling automatons accounting for functional and process characteristics f) Set and check quality control units and fusegear, in particular automated test equipment, work safety equipment and supply and disposal installations g) Register and document operating characteristics and production data				14
4	Recommissioning of units and automated production installations (Par. 1d, subsec. (2), sec. 6)	a) Check functions of modules and units especially se..sor, actuator, drive, power electronics, pneumatic and hydraulic modules and units b) Conduct test runs accounting for nominal and limit values and input user programmes c) Save and document programmes and data				10
5	Maintenance of automated production installations (Par. 1e, subsec. (2), sec. 6)	a) Identify malfunctions and localize causes by means o. systematic troubleshooting and by using diagnostic equipment b) Rectify malfunctions, in particular by means of mechanical and electnc interventions and programme changes according to instructions and documents or have them eliminated c) Conduct preventive servicing and maintenance according to documents				14

BEST COPY AVAILABLE

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
B. Instrument Technology						
1	Fabrication of mechanical parts on machine tools (Par. 2a, subsec. (2), sec. 6)	a) Select coolant lubricants and tools accounting for cutting data b) Machine workpieces to an accuracy of ±0.1 mm and a surface finish of between R_t = 10 µm and R_z = 63 µm by means of longitudinal spherical, transverse face, transverse plunge-cut, transverse cutting off and internal longitudinal turning according to drawings c) Drill/bore workpieces on turning machines d) Cut threads on turning machines with thread-cutting dies and taps e) Mill workpieces to an accuracy of ±0.1 mm and a surface finish of between R_t = 16 µm and R_z = 40 µm according to drawings f) Engrave workpieces				4
2	Fabrication of electromechanical and electric components (Par. 2b, subsec. (2), sec. 6)	a) Fabricate wire resistors, in particular accounting for load carrying capacity, inductivity and resistance tolerances according to documents and patterns b) Wind coils by hand and with winding machines according to documents and patterns c) Assemble coils and iron cores to components d) Fabricate cable harnesses according to circuit documents, building specifications and patterns				10
3	Fabrication and insertion of components in printed circuit boards (Par. 2c, subsec. (2), sec. 6)	a) Design a wiring path layout and an assembly diagram for one-side coated printed circuit boards up to 'European format' according to circuit documents and specifications and draw up parts lists b) Fabricate one-side coated printed circuit boards accounting for regulations on hazardous working materials c) Insert components in printed circuit boards according to documents with components and wire in laboratory wiring				8
4	Assembly and wiring of power and communications modules and units (Par. 2d, subsec. (2), sec. 6)	a) Select and prepare lines accounting for unit characteristics, in particular coaxial lines and striplines and heat proof lines according to documents b) Assemble and wire modules and units, in particular accounting for screening, earthing, disturbance suppression and static charge according to documents c) Assemble and wire modules with electric fine mechanical components				20

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		d) Assemble and wire modules and units, in particular accounting for hum pickups, electric and electromechanical interference and undesirable couplings according to documents e) Install and wire power semiconductors accounting for their layout with regard to cooling				
5	Checking, measurement, setting and adjustment of modules and units (Par. 2e, subsec. (2), sec. 6)	a) Measure voltage, amplification, frequency and pulses, in particular in amplifiers, filters and oscillators according to documents b) Check bit patterns on modules and units, in particular output and input signals using test programmes c) Check programmable controllers with the aid of test routines according to documents d) Check, set and adjust amplifiers, filters and oscillators according to documents e) Check, set and adjust electronic power functional units, in particular rectifiers, converters, and rectifier inverters according to documents f) Check functional units for control and measuring installations, in particular regulators, transducers, measuring amplifiers and measuring converters according to documents g) Apply test programmes for modules and units according to documents and instructions h) Check and set mechanical and electromechanical functions in modules and units according to documents i) Conduct checks of units, in particular insulation, earthed conductors, high voltage radio interference suppression according to documents k) Select methods to measure rotational speed, pressure and temperature, in particular with sensors, transducers, measuring converters and measuring amplifiers, set up and adjust measuring equipment and conduct measurements				16
6	Commissioning of modules and units (Par. 2f, subsec. (2), sec. 6)	a) Commission modules and units accounting for the individual functions and the overall function including adaptation to peripheral units according to documents b) Conduct and record test runs with units according to documents and instructions c) Hand over units to operator and explain operation				6

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
7	Maintenance of modules and units (Par. 2g, subsec. (2), sec. 6)	a) Inspect and replace worn parts, in particular mechanical and electromechanical parts b) Identify malfunctions by means of systematic fault localization and rectify these, replace faulty components and functional groups c) Maintain, inspect and service modules and units applying regulations specific to equipment d) Record maintenance work			14	

GENERAL SYLLABUS
FOR THE VOCATIONAL TRAINING OF COMMUNICATIONS FITTERS

Annexe 4
(to sec. 8)

I. Basic Training

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
1	Vocational training (Par. 1, subsec. (1), sec. 7)	a) Explain the meaning of the training contract, particularly conclusion, duration and termination b) Specify the mutual rights and duties in the training contract c) Specify possibilities for further training	to be imparted during the entire training period			
2	Explain structure and tasks of training enterprise (Par. 2, subsec. (1), sec. 7)	a) Explain structure and scope of activities of training enterprise b) Explain basic functions of training enterprise, such as procurement, manufacture, sales and administration c) Specify relations of training enterprise and its workforce to industrial organizations, trade associations and trade unions d) Describe the basis, mandates and mode of operation of training enterprse's labour relations bodies				
3	Labour legislation and legislation on wages and safety and health at work (Par. 3, subsec. (1), sec. 7)	a) Specify main parts of contract of employment b) Specify major provisions of wage agreements affecting training enterprise c) Explain functions of safety and health provisions, trade associations responsible and trade inspectorate d) Specify main provisions of law on safety and health at work affecting training enterprise				
4	Industrial safety, environmental protection, data protection, rational use of energy (Par. 4, subsec. (1), sec. 7)	a) Explain accident and health hazards especially of electric power, machines, hazardous working materials and workplaces and take measures to avoid them b) Observe major provisions and safety regulations when working with electric operating equipment and plant as stipulated in the trade accident prevention regulations (UVV VBG4) and DIN provisions for electrics/electronics (VDE) and other job-related provisions on health and safety at work c) Describe response in the case of accidents and fire and apply first aid measures d) Specify sources of environmental pollution at workplace and contribute to its reduction e) Specify and observe job-related regulations on data protection f) Specify forms of energy used in the training enterprise and possibilities for more rational utilization of energy in the immediate workplace and environment				

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
5	Fabrication of mechanical parts (Par. 5, subsec. (1), sec. 7)	a) Read single part drawings in elevation and sectional views attending to types of line, scale, measurement entries with tolerance specifications and the symbols for surface finish and draw sketches				
		b) Read assembly drawings, explosion views and parts lists				
		c) Prepare and maintain tools, units, machines and auxiliary materials				
		d) Determine work steps for the task to be performed and estimate the times required				
		e) Select and handle measurement tools to measure and check lengths, angles and surfaces with the requisite measuring accuracy				
		f) Measure lengths with rules and vernier calipers				
		g) Measure angles with protractors and check them with angle gauges				
		h) Check surfaces using the light slit method for evenness and shape accuracy				
		i) Line out, grain and mark workpieces accounting for material properties				
		k) Select tools and coolant lubricants accounting for the material to be machined, the machines and auxiliary materials				
		l) Clamp workpieces and semi-fabricated components for machining accounting for surface protection		8		
		m) Saw metal and plastic sheets, plates and profiles				
		n) File and deburr metal and plastic workpieces to an accuracy of DIN 7168 and a surface finish of R_t 25 smooth and angular				
		o) File and deburr roundings on metal and plastic workpieces true to shape				
		p) Clamp drills/borers and counterboring/countersinking cutters with drill chucks and clamping cones				
		q) Produce bores and countersinks in sheets, plates and profile parts with manually guided and stationary boring/drilling machines				
		r) Produce counterbores with stationary boring/drilling machines				
		s) Cut internal threads in metal and plastic workpieces				
		t) Cut external threads in metal tubes/pipes and bars with thread-cutting dies				
		u) Cut metal sheets and plastic plates with hand and hand-leaver shears and punch with punching tools				

77

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		v) Cold bend metal sheets and profile parts w) Straighten workpieces deformed by cutting or bending				
6	Produce mechanical connections (Par. 6, subsec. (1), sec. 7)	a) Produce connections by means of screws, bolts and washers and fasten using fastening elements, in particular with spring rings, tooth-lock washers and varnish b) Select tools, solders and flux for soft welding accounting for properties and use c) Produce soft weld connections for mechanical and electric loads with electric soldering bits d) Select adhesives according to properties and use and bond similar and different materials according to instructions and documents	2			
7	Assembly and wiring of mechanical, electromechanical and electric components to modules (Par. 7, subsec. (1), sec. 7)	a) Read technical drawings and circuit documents of modules, in particular terminal diagrams, unit wiring diagrams and circuit diagrams according to DIN 40719 and draw sketches b) Prepare and maintain tools, units, machines and auxiliary materials c) Determine work sequences to perform a given task, estimate the times required d) Prepare single-wire and multi-wire, screened and unscreened lines e) Attach terminal parts, in particular lugs, connector sleeves and plug sockets to lines f) Connect lines and attach to terminals, in particular by welding, clamping and plugging g) Prepare construction elements and components, in particular resistors, condensers, capacitors, coils and semiconductor elements for installation in modules, in particular by cutting off to length, bending, isolating and tinning according to instructions, documents and patterns h) Assemble construction elements and components, in particular profile parts, sheets, plates and fittings to mechanical modules, in particular to slide-in/plug-in units and housings i) Assemble construction elements and components in particular resistors, capacitors, coils, plug and socket connectors, fuses, switches, relays, contactors and signal lamps to electric modules k) Connect electromechanical and electric construction elements and components to form modules, in particular by means of overhead, trunk, channel and stripline wiring		10		

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
8	Preparation, laying and connection of lines to terminals (Par. 8, subsec. (1), sec. 7)	a) Read technical plans and circuit documents, in particular circuit diagrams, block diagrams, installation schedules and terminal diagrams according to DIN 40719 for basic power and communications circuits and draw sketches b) Select, prepare and maintain tools, units, machines and auxiliary equipment c) Determine work sequences to perform given tasks and estimate the times required d) Select power and communications lines, in particular accounting for the type of layout and use according to tables e) Determine lines paths for prescribed end and junction points according to building and local conditions f) Lay and secure lines with clamps in pipes and channels according to documents and instructions g) Prepare lines for connection to terminals and attach terminal parts h) Connect lines according to instructions and documents and connect to operating equipment	10			
9	Measurement of zero-frequency and alternating quantities and checking of components and modules (Par. 9, subsec. (1), sec. 7)	a) Select methods and measuring units, accounting in particular for internal resistance, estimate measuring errors and set up measuring equipment b) Measure voltage, current, resistance and power in direct-current circuits and calculate their ratios c) Register, present and evaluate measurement series and characteristics, in particular of resistances related to voltage, light and temperature d) Measure sinusoidal alternating voltage and sinusoidal alternating current in circuits with effective resistances e) Measure amplitude and cycle duration, in particular with an oscilloscope f) Check characteristics of components and construction elements, in particular of resistors and relays or contactors according to documents g) Check circuit layout, nominal values and function of modules according to documents and set nominal values h) Test circuits with basic logical functions, in particular AND, OR, NOT according to documents		10		

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
10	–	In further training the training contents of Nos. 5, 7 and 8 of this part of the General Syllabus should be imparted depending on the specific operating requirements and the trainee's progress	12			

II. Specialized Training

1	Assembly and wiring of mechanical, electromechanical and electric modules and units (Par. 10, subsec. (1), sec. 7)	a) Read technical drawings and circuit documents of modules and units, in particular layouts, circuit diagrams and equivalent circuit diagrams according to DIN 40719 and draw sketches b) Allocate and prepare components according to specific handling and installation specifications in particular with regard to avoiding static charge and thermal load, insert these in printed circuit boards and insert and remove by means of soldering c) Assemble modules and units according to instructions, documents and patterns d) Select lines in particular with regard to colour codes, minimum cross sections and current carrying capacity according to provisions on DIN norms for electrics/electronics (VDE) e) Prepare lines and terminal parts, in particular mains plugs, couplings and multipolar plug and socket connectors and attach according to documents f) Wire modules and units with different wiring methods according to instructions, documents and patterns g) Compare layout and wiring of modules and units with technical documents, in particular by means of visual inspection and check continuity of electric connections h) Correct faults and document changes		9		
2	Mounting and installation of functionally demarcated plant sections (Par. 11, subsec. (1), sec. 7)	a) Read technical plans and circuit diagrams in power and communications technology, in particular communications charts and layouts, and draw sketches b) Mount operating equipment c) Determine line and cable paths under local conditions d) Select power and communications lines or cables accounting in particular for use, the mechanical and electric load and the method of wiring/cabling e) Lay, secure and connect lines or cables accounting in particular for mechanical load and local conditions		9		

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		f) Compare mounting and installation with technical documents, in particular by means of visual inspection and check continuity of electric connections g) Correct faults and document changes				
3	Checking, measuring and setting of modules and units (Par. 12, subsec. (1), sec. 7)	a) Select methods to measure sinusoidal zero-frequency quantities in circuits with complex resistances and sketch measuring circuits, set up measuring equipment, measure voltage and current, determine phase shift b) Register by drawing voltage, current, impedance and reactance resistance accounting for phase shift c) Test function of digital circuits with basic logical functions, in particular circuits with pulse shapers and multivibrators according to instructions and documents d) Test function of digital circuits with integrated combinatory logic, in particular with coders, decoders, multiplexers and demultiplexers e) Measure pulse characteristics, in particular duration, frequency and pulse duty factor according to documents and present the pulse shape f) Select and set up testing and measuring units and test and measuring circuits to test the function of components, modules and units g) Test and set direct-current and alternating current modules and units in particular with resistors, coils, capacitors, transformers and discrete semiconductor elements according to test, adjustment and circuit documents h) Check and set electromechanical modules, in particular with relays, contactors and servo drivers according to test, adjustment and circuit documents and data sheets i) Check and set mechanical modules in particular with switches and drives according to test documents and instructions k) Represent test and measuring results in the form of tables and diagrams and evaluate according to instructions			6	
		l) Select measuring units to measure levels, frequencies, pulses and pulse trains m) Check, measure, set and adjust levels and frequencies, in particular in low frequency amplifiers and generator circuits n) Check, measure and set pulses and pulse trains, in particular in pulse generators, pulse shapers, pulse counters and registers				

BEST COPY AVAILABLE

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		o) Check functions of multivibrators with static and dynamic inputs according to documents p) Check functions of basic circuits in sequential logic, in particular of counters/meters, registers and memories according to documents q) Check function of programmed logic modules according to documents r) Document test and measuring results		7		
4	Commissioning of modules, units and functionally demarcated plant sections (Par. 13, subsec. (1), sec. 7)	a) Check effectiveness of protective measures against direct contact according to instructions and regulations by means of visual inspection b) Conduct insulation checks according to regulations c) Check effectiveness of protective measures in the case of indirect contact, in particular protection by switching off with overcurrent protectors and fault current equipment in TN systems and by safety separation according to regulations d) Check equipment to protect against electrostatic charge e) Check protective equipment related to construction according to documents f) Commission modules, units and demarcated plant sections according to documents g) Conduct and document function tests under operating conditions according to documents		2		
		h) Test individual functions and overall function of units or plant sections according to documents i) Check effectiveness of protective measures in the case of indirect contact, in particular protection low voltage and protective insulation k) Commission units or plant sections according to documents and instructions, measure and document operating characteristics		2		
5	Assembly, wiring, mounting and insulation of communications modules, units or plant sections (Par. 14, subsec. (1), sec. 7)	a) Read circuit documents for modules, units and plant sections and draw sketches b) Determine line layout for printed circuit boards up to 'European format', draw up installation schedules and parts lists c) Insert components into printed circuit boards according to documents and connect using laboratory wiring		9		

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		d) Assemble and wire components and modules to units or plant sections accounting for thermal, mechanical and electric load and magnetic and electric interference according to instructions, documents and patterns e) Select and lay lines and cables for communications plant				
6	Localization, identification and rectification of faults in communications units or functionally demarcated plant sections (Par. 15, subsec. (1), sec. 7)	a) Localize and identify causes for mechanical and electric faults in communications units or functionally demarcated plant sections, in particular by functional testing to module level according to instructions and documents b) Rectify faults in units or plant sections, in particular by replacing faulty modules		4		
7	Operation of data processing units and application of programmes (Par. 16, subsec. (1), sec. 7)	a) Operate data processing units, in particular keyboards, data displays, external memory units and printers b) Read and sketch programme sequences c) Apply programmes, in particular operating systems, user and test programmes according to instructions and documents d) Write, test and apply programmes, in particular in a problem-oriented programming language with approx. 20 instructions according to documents, in particular instructions lists		4		

III. Advanced Training in Subject Areas

A. Information Technology

1	Assembly, wiring, mounting and installation of information and data processing modules, units and plant (Par. 1a, subsec. (2), sec. 7)	a) Assemble and wire modules and units according to documents and models, in particular accounting for bus connections and interfaces b) Select, lay, connect and connect lines or cables to terminals accounting for major characteristics, in particular line loss, and wave impedance c) Mount and install plant, in particular accounting for interfaces according to documents and instructions d) Assemble and electrically wire information and data processing measuring and test equipment and regulators, in particular counters/meters, time, frequency and pulse measuring units and measuring transformers according to documents and patterns			20

No	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
2	Checking, measurement, setting and adjustment of information and data processing modules, units and plant (Par. 1b, subsec. (2), sec. 7)	a) Check, measure, set and adjust analogue signals and characteristics, in particular amplification, damping, frequency response, phase angle and position, impedance, bandwidth and sensitivity according to documents, test specifications and data sheets b) Check, measure, set and adjust digital signals and characteristics, in particular pulse characteristics and time sequence of pulses according to documents, test specifications and data sheets c) Check, set and adjust sensors to register non-electric quantities, in particular light, temperature, rotational frequency and angle, pressure, pull and path and their converters according to documents, test specifications and data sheets d) Check and adjust actuators, in particular servo drives and valves according to documents e) Input, test and apply programmes, in particular for measuring and test purposes in machine-oriented language according to documents, in particular instruction lists and programme flowcharts f) Document and evaluate test and measuring results				20
3	Commissioning of information and data processing units and plant (Par. 1c, subsec. (2), sec. 7)	a) Check and set functions of data input units, in particular keyboards, displays and sensors b) Check and set functions of data output units, in particular displays, printers, memories and actuators c) Check functions of data processing and transfer units and connecting elements and interfaces d) Check functions of computer and data processing units and plant by means of test runs according to documents and instructions e) Check and set equipment for measuring, control, signalling and monitoring, in particular sequence controls, regulators, measuring equipment, actuators/final control elements and signal transfer equipment f) Conduct test runs on units and systems according to documents and instructions g) Document work conducted and test results h) Hand over computer and data processing units and systems to user and explain operation				18

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
4	Maintenance of information and data processing units and plant (Par. 1d, subsec. (2), sec. 7)	a) Inspect and maintain units and plant according to inspection and service schedules, replace worn parts and reset operating characteristics, document work conducted b) Systematically localize, identify and rectify malfunctions and faults in information and data processing units and plant with the help of service documents, document work conducted c) Extend and alter information and data processing units and plant according to documents and instructions, document work conducted			20	
B.	Telecommunications Technology					
1	Assembly and wiring of modules to units and mounting, installation and extension of telecommunications plant (Par. 2a, subsec. (2), sec. 7)	a) Allocate material, operating equipment and tools, plan work sequences according to safety work organization and economic aspects b) Assemble and wire modules to units, in particular to telephone terminals, data terminals and signal units according to documents c) Set up, secure and connect terminals accounting for interface conditions according to documents d) Select lines and cables accounting for major characteristics, in particular line capacity, line loss and wave impedance e) Lay, secure, connect lines and cables to terminals accounting for special safety transmission conditions and the locality and protect the connecting points f) Set up, align, secure, assemble electrically connect and wire telecommunications systems for language, data, text and images, in particular branch exchanges and at least one of the following types of system: aa) switching plant bb) sound systems cc) cable systems dd) signalling systems g) Extend modules, units and plant accounting for function and document the work conducted				20
2	Checking, measurement, setting and adjustment of telecommunications modules, units and plant (Par. 2b, subsec. (2), sec. 7)	a) Check and measure analogue signals and their characteristics, in particular amplification, damping and frequency response according to test specifications and data sheets b) Check and measure digital signals, in particular pulse characteristics and the time sequence of pulses according to test specifications and data sheets				10

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		c) Set and adjust modules and units according to circuit documents and test specifications, data sheets and instructions d) Apply test and measuring programmes according to instructions e) Evaluate and document test and measuring results				
3	Commissioning of telecommunications units and plant (Par. 2c, subsec. (2), sec. 7)	a) Check and set individual functions and overall function, in particular characteristics, parameters and fusing functions in units and plant and their interfaces b) Check functions with test programmes c) Control and set performance characteristics according to documents d) Conduct test runs on units and plant according to instructions and documents e) Document test and measuring results in tabular form and evaluate and document according to documents and data sheets f) Hand over units and plant to user and explain operation				14
4	Maintenance of telecommunications units and plant (Par. 2d, subsec. (2), sec. 7)	a) Inspect and maintain units and plant according to inspection and service schedules b) Systematically localize, identify and rectify malfunctions and faults in units, plant or systems using test programmes and with general and system related measuring equipment according to documents and instructions c) Service modules, units and their connecting equipment, in particular in private branch exchanges at least in one of the following kinds of plant aa) switching plant bb) sound systems cc) cable systems dd) signalling systems d) Alter modules, units and plant accounting for function and operational state e) Control and document work conducted on units and plant				20

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
5	Operation of telecommunications units and plant (Par. 2e, subsec. (2), sec. 7)	a) Wire input and outputs of functionally demarcated plant sections accounting for operational state b) Alter operating and performance characteristics of functionally demarcated plant sections accounting for the operational state by encoding and switching on, off and over according to instructions c) Conduct equivalent circuiting for functional units of demarcated plant sections accounting for the operational state by hand or via a programme according to documents d) Replace programmes for functional units accounting for the operational state according to instructions e) Input and save data for functional units accounting for the operational state according to instructions f) Update documents for functional units accounting for relevant specification according to instructions g) Observe and evaluate operational status messages from plants or systems				14
C.	Radio Technology					
1	Assembly, wiring, mounting and installation of radio modules, units and plant (Par. 3a, subsec. (2), sec. 7)	a) Assemble and wire low and high frequency modules and units, in particular accounting for parasitic capacities and inductance, hum pick-ups, magnetic and electric interference and undesirable couplings according to documents and patterns b) Select lines or cables accounting for major characteristics, in particular line capacity, line loss and wave impedance c) Mount and install transmitter and receiver plant according to documents				10
2	Checking, measurement, setting and adjustment of radio technology modules, units and plant (Par. 3b, subsec. (2), sec. 7)	a) Check, measure and set low frequency signals and characteristics, in particular amplification, sensitivity, frequency response, distortion factor, and impedances according to documents, test specifications and data sheets b) Check, measure, set and adjust high frequency signals and characteristics, in particular sensitivity, selectivity, amplification, damping, transmission curves, bandwidths and signal-to-noise ratios according to documents, test specifications and data sheets c) Check, measure and set digital signals and characteristics, in particular pulse characteristics and time sequence of pulses according to documents, test specifications and data sheets				10

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		d) Check and measure electric quantities in aerial systems, in particular according to documents, test specifications and data sheets				
		e) Check, set and adjust modules in low frequency units, in particular amplifiers, equalizing networks, sound transducers according to documents, test specifications and data sheets f) Check, set and adjust modules in high frequency units, in particular amplifiers, filters, generators, modulators and demodulators and mixing stages according to documents, test specifications and data sheets g) Check, set and adjust regulating circuits in high frequency units, in particular for voltage stabilization, gain control and frequency regulation (AFC, PLL) according to documents test specifications and data sheets h) Check and set functions of modules, in particular with operational amplifiers, D/A converters, A/D converters and optical couplers as well as switching power supplies according to documents, test specifications and data sheets i) Check, set and adjust sensors and converters for non-electric values, in particular for temperature, light, rotational speed in units and plant according to documents, test specifications and data sheets k) Document and evaluate test and measuring results				16
3	Commissioning of radio units and plant (Par. 3c, subsec. (2), sec. 7)	a) Control, check, measure and set functions of analogue units and plant according to specifications b) Control, check, measure and set functions of digital and programme controlled units and plant, in particular data transfer via input and output modules, according to regulations c) Check and measure functions of units and plant with test programmes d) Conduct test runs of units and plant according to documents and instructions e) Document work conducted and test results				16
4	Maintenance of radio modules, units and plant (Par. 3d, subsec. (2), sec. 7)	a) Inspect units and plant b) Maintain units and plant to ensure operation and safety according to service schedules				6
		c) Systematically localize, identify and rectify causes of mechanical and electric faults in units and plant by means of inspection, testing and measuring using service documents and document work conducted				

No.	Part of Occupation Profile	Skills and knowledge to be imparted including independent planning, execution and control	Standard time in weeks in training year			
			1	2	3	4
1	2	3	4			
		d) Extend and alter units and plant according to documents and instructions e) Update circuit diagrams and circuit documents for modules, units and plant			20	